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First General Rate Reduction

IT WAS a good move on the part of the railways to reduce rates 10 per cent on agricultural products in advance of action on further proposed wage reductions which, they promise, are to be passed on to the public if granted. It indicates a willingness to add to the stress under which they are working and to suffer some decrease in the rising rate of their earnings. This attitude will bring public appreciation, even if it will not—and it should not—decrease the public's demand for lower rates. Rate deflation is as necessary as deflation of other charges upon the public. That wages need deflation simultaneously is not to be doubted, but a general rate reduction running ahead of wage lowering will tend to accelerate the latter.

Leadership in Industry

LAST week's paving-brick conference in Washington illustrates the helpfulness of the leadership in industry being afforded by the Department of Commerce. Secretary Hoover's well-known sympathy with the idea of eliminating all forms of industrial waste and the emphasis he has placed on the desirability of eliminating indefensible varieties makes it logical for industries that are burdened with an abnormal number of styles to appeal to the department for assistance. The fabricated products department of the U. S. Chamber of Commerce is working to the same ends and is furnishing the stimulus that is leading some industries to the department. In one way the department had very little to do with the result achieved last week; it took no part in the meeting other than to stress the desirability, as a general principle, of eliminating industrial waste; it offered no survey or report on the subject; it had no experts to counsel what, in detail, should be done. In another way, it had all to do with the good result, for without its encouragement the meeting might not have been held. It was entirely impartial. It had neither manufacturing ends to serve nor engineering theories to exploit or conserve. Its attitude in that conference should be an encouragement to other industries which need variety elimination.

Achievement in Detail

PROGRESS in any art finds reflection in the perfection and power of its detail devices. In the light of this principle the Stock Exchange Extension framing described in this issue by one of its designers takes high rank as a demonstration of how far the art of applying rolled steel to structural uses has progressed. The architect put unusually severe demands on the structural engineer by suppressing an entire story of interior supports and asking him to carry more than twenty stories over a large hall. The conditions imposed by this demand not only necessitated the remarkably heavy truss construction shown, but also restricted the wind bracing seriously. In respect to both of these difficulties the key to success lay in efficient, ingenious detail design rather than in new method or conception. Thus, the transfer of huge forces through the trusses was accomplished within surprisingly confined space limits by extreme concentration of metal in main members and by integration of multiple gusset plates with the truss members to such degree that the end diagonals are nothing more than splices connecting the gussets. Similar difficulties, though they are less obvious, were overcome in the wind-girder system, again through command of detail. The merit of the result achieved is easily overlooked, since the finished construction proves the possibility rather than the near impossibility of meeting the requirements imposed. Yet those who have themselves handled difficult cases of steel detailing will appreciate the problems involved and the relation of detail perfection to their solution.

Approaching Great Problems

BURIED in the daily routine of professional tasks amenable to precedent, rule, and weighing of dollar against dollar, the engineer tends to lose his appreciation of the creative thinking on which enduring achievement in the art depends. Indeed, the conceptions and intuitions of which it is composed are in a field somewhat remote and separate from the ordinary currents of professional thought, and are easily forgotten in the constant use of the tools that serve our work-a-day purposes. The thoughtful essay of Gustav Lindenthal on long-span bridge design, page 861 brings back to the consciousness the transcendent importance of broad contemplation and integral grasp of a problem. His stressing of the architectural viewpoint strikes near the root of the matter—not, we take it, because ornament or curved beauty-lines are of any significance, but because the structure that shall fulfill all its purposes most fittingly must be seen by the mind as an entity and must be evolved in complete harmony of its several elements; it cannot be pieced together of separately devised parts. In broad, truly creative consideration, the form and functioning of each element develops in subordination to form and functioning of the whole. It is in the great problems that this method of approach is indispensable—in those problems which, regardless of mere bulk, strain to the limit the capacity of materials or method. But its power and inspiration have value even in everyday work, in degree depending on the individuality of the engineer. If, then, the essay shall strengthen the engineer's regard for broad contemplation of his problems, it will contribute measurably to the advancement of the profession.

Solidity and Success

PRESIDENT HIBBEN, in opening the new term at Princeton University last month, pleaded with the students for "a revival of learning." In thorough intellectual discipline he saw aids in the settlement of

the difficult problems that have followed the wake of the war. It is not uncommon to hear emphasis laid upon the need for thorough scholarship as opposed to the veneer which is all that many men acquire in college. It is true that energy counts heavily in getting things done and rising to high place. But it is a mistake to think that typical American "pep" and selling ability are alone sufficient to carry men to high achievement. These things are valuable, but they are most valuable when they are the assets of a man with a well-disciplined mind.

Is the St. Lawrence Waterway Practicable?

NEW YORK—both city and state—is beginning to take notice of the St. Lawrence waterway project. The governor is making stump speeches against it, the metropolitan newspapers are viewing it with alarm and the Port Authority is calling for a counter-offensive against the propaganda of the Northwestern States association which favors the project. This is a good thing. The country needs waking up as to the magnitude of the proposition and its national importance. A good fight will serve to clear up misapprehensions and to decide the issue in the clear light of facts rather than on the basis of sectional preference and interest.

Much loose talk has been indulged in by both sides. New York, through its governor, has centered its opposition on the claims that the navigation advantages of the St. Lawrence can be more cheaply and safely served by the Barge Canal and that the power prospects are merely a scheme of the "interests" to get free power and charge excessive rates. The first claim has been answered epigrammatically by Governor Allen, of Kansas—"We are bound for Liverpool, not Buffalo." In other words, the transshipment charges at Buffalo and New York City which served so admirably to swing those two communities into a majority for the Barge Canal in 1901 are a horse of another color when viewed as added costs to the shipper. As to the "power grab," can any one take it seriously in these days of public rate control? The West, on the other hand, seeking a cheaper outlet for its grain, looks at the difficulties of navigation, the cost of the improvement, and the prospects for freight movement other than grain through the rosiest of glasses.

Out of the welter of biased argument three questions emerge—Is the project physically possible? Will it pay? How is it to be built, controlled and paid for? They may be answered by the forthcoming report of the International Commission. Meanwhile, what do we know about them?

Engineers have no doubt as to the feasibility of the waterway. To build a 25- or 30-ft. channel from Montreal to the Lakes and simultaneously to provide millions of horsepower is quite possible. Already one general plan has been submitted by international government engineers and several other schemes are before the Commission. Furthermore, it will be quite practicable to build an 8,000-ton ocean-going steamship which can be operated economically through the Great Lakes and on the St Lawrence—not as economically as a present lake steamer, but that is beside the question for there is to be no competition between the lake steamer plying only between lake ports and an ocean steamer tying up lake and ocean. Engineering details of the waterway will have to be worked out, but that is merely a question of time and talent.

As to the economics of the project, it should not be necessary to remind men with any regard for honesty in figures that the costs of the navigation features must be separated from those of the power-development, and that against each must be set separately the corresponding uses and benefits. To say that the power rates will pay a satisfactory return on the cost of the whole project is to ignore the practice of public regulatory bodies in basing returns on the cost of service. No commission will permit electric-rate earnings on the whole cost when a large part of the expenditure has been incurred by navigation features. The best that can be hoped for is that there will be a fair spread between the return allowed through the power charges and the rate at which the government can borrow money to finance the project.

If it be true that the proponents must be mindful in the use of figures equally true is it that the opponents must be honest and not set the whole cost of the project against the navigation benefits.

Whether the project from the navigation side is economically feasible remains to be seen. Estimated first costs now being used by the proponents are undoubtedly too low and the estimated freight flow a matter of guesswork. Bulk shipments—grain, coal, ore, raw chemicals—will be moved more cheaply, not only where no transshipment is required but also, on account of the perfection in bulk transfer, to and from inland locations where part rail haul is necessary. Bulk shipments, however, are only a part of the necessary business a lake to ocean waterway must do and the economies of package freight have not been thoroughly examined. Obviously shoes made at Brockton could be hauled by motor to Boston, loaded on a ship which would deliver them to a pier warehouse at Duluth cheaper than they could be by rail, but equally obviously a machine made at Pittsburgh could not be shipped to New York, sent by steamer to Cleveland and by rail thence to Louisville cheaper than over an all-rail route. Somewhere between these two examples are the economic limits of the waterway. Similar reasoning applies to the area of economic delivery beyond lake ports for goods arriving from Europe via the St. Lawrence.

As to power economies, there should be no question. The greatest water power in the world is going to waste on the St. Lawrence. It must and will be developed. The present issue is whether that power is to be developed by itself or whether the works necessary to create it shall be utilized to help create a navigable channel. Any investigation of the economies of the waterway as a freight carrier must be based on the cost which the navigation features add to the power project.

The last question to be answered is largely in the hands of the diplomats. How are we going about building an international improvement, which may prove directly profitable—that is in actual cash return—and guarantee equal rights, privileges and control. Will we form a corporation, with stock jointly held by the two countries, and issue bonds to pay for the improvement or will we form a joint commission and leave each country to appropriate the necessary money, to be raised of course by taxes equably distributed over the whole people? These are important details that have never been discussed by either country officially. The International Joint Commission will have to give some attention to them before individuals can consider them. As to selfish national interests there need be no question.

There are opponents and proponents on both sides of the line. And in the incredible event of war, no advantages are offered either nation; the military authorities are agreed on that.

What then does the St. Lawrence case boil down to? That there is a decidedly predisposing argument in favor of the project, but that much remains to be investigated by expert authority. That the West overemphasizes benefits and underestimates difficulties. That the opposition of New York is largely selfish, one more indication of the strange fear that apparently hangs over the state and city of being dispossessed of its premier position. How curious that a state could cheerfully gamble away $101,000,000 (which has grown to half as much again) on a doubtful canal project and then oppose the expenditure of two or three times that much by the whole country on a scheme which insures from the power revenue at least a return on more than half the investment—a business proposition so superior to that of the Barge Canal that no comparison is possible. Widespread discussion is going to be the best possible thing for the project, but even that discussion will not begin to tell until the International Joint Commission puts before both countries the data which have resulted from its two-year investigation.

Fewer Sizes of Paving Brick

AN AUSPICIOUS start was made last week in the elimination of indefensible designs in products manufactured for the construction field when a conference of engineers and manufacturers approved the reduction in current varieties of paving brick from 66 to 11. Work of this sort was undertaken during the war, and is now being resumed.

The recommendations in the paving-brick case, if approved by the organization represented, should bring to the construction field the benefits commonly conceded to flow from concentration on a limited number of models or varieties. Lost time in changing machines will be reduced, production will be increased, and overhead spread over a greater number of units. Less capital will be tied up in patterns, dies and special machinery. Carrying charges on stock will be reduced. These benefits, primarily, accrue to the manufacturer. In a competitive market they pass to the consumer.

We do not infer that reductions in paving-brick prices can be looked for at once, or even soon, but the healthier industry that will result must eventually show its effect in better service, a better product or lower prices.

The effort at Washington is to be particularly commended because the benefits will be secured without any sacrifice in quality, desirability or service of the product. For the manufacturer the elimination of 55 varieties from the current list is a radical improvement. Technically, however, the step is not radical. The varieties eliminated have no superiority over the varieties retained. To put it more broadly, the results sought by the paving and highway engineer can be obtained without loss by using the varieties retained.

In reaching its decisions the conference sought to balance manufacturing against engineering considerations. For manufacturing reasons a still smaller number of accepted varieties is desirable, yet engineering practice dictated retaining eleven. With these varieties the engineer has a choice of 3, 3½- or 4-in. pavements, which covers all the demands of present paving practice.

It should be remembered, too, that determinations of this sort are not made for all time. If future conditions should demand new sizes last week's recommendations will need revision, and this is provided for by the designation of a permanent committee composed of representatives of interested organizations. Moreover, there is nothing to prevent any engineer from getting anything he wants, provided he is willing to pay a premium in proportion to the added cost. In the past, the extra cost of freak sizes was loaded on to buyers generally. Now it will properly be assessed against those who insist upon departing from standard. This will create some dissatisfaction, yet we acquiesce in this trade practice in many other trade lines. In fact, the practice is well-nigh universal. If we choose a "special" I-beam for a steel structure, we expect to pay an additional price for it.

Last week's step, however, does not complete the work. It must be approved by all the organizations represented at the meeting. This approval should be prompt and hearty. The proposed simplification is in the interest of all concerned.

Wire Cable Questions

WHAT Mr. Lindenthal says of suspension bridge towers is likely to stir up various reflections, from those which revolve about the properly stigmatized "bandy-legged towers" of the Williamsburgh Bridge (and they are now proposing to call it the Roosevelt Bridge!) to those which doubt the possibility of dogmatizing on principles of steel designing. We are still fairly far back in the stone age as regards notions of architectural aesthetics, and men will disagree on questions of the beauty of steel towers. Everyone, no doubt, wishes to see stress carried visibly in naturally spreading paths from load to base; but, though we all think we know how this is to be accomplished in stone, in cast iron or in concrete, the strength of these materials is patently foreign to that of steel, and forms must therefore differ. We can afford to wait for fuller development of ideas on this subject.

On the other hand, the subject of cable strength is of immediate urgency, since it concerns the most efficient structural element we possess, and affects the possibility of many river crossings, quite aside from the fact that, if the wire cable is ruled out of the long-span field, one of our most highly admired bridge forms must be modified. Mr. Lindenthal casts doubt on the sufficiency of parallel-wire construction, as heretofore practiced, for extremely large cables. His reasoning is so weighty as to suggest that the bridge-building profession is under obligation to bring to light all facts discoverable as to the production, the stress behavior and the permanence of existing large bridge cables. That has not yet been done, but should be done in the future. Beyond this we have the possibilities of stranded cables, of eyebar chains and of built plate chains to consider—a large field for exploration in the fuller exploitation of the suspension bridge.

At the moment the subject is in highly activated condition, since the engineers of the Delaware River bridge have built up their project on parallel-wire cables of unprecedented size—and difficulty, says Mr. Lindenthal—while he himself is planning to use eyebar chains of enormous proportions for his great Hudson River crossing.

Heavy Steelwork in New York Stock Exchange Extension

Four Trusses Weighing 150 Tons Each Required To Span New Board Room and Carry 24-Story Building—Steel for Upper Stories Used in Erection Falsework

By John W. Pickworth
Member of the firm of S. C. Weiskopf, Consulting Engineers, New York

OF THE MANY unusual engineering problems in building construction presented by a crowded business district, the addition to the New York Stock Exchange, now in course of erection, contains some of the most interesting and unique. The present building, an 8-story structure situated between Broad and New Sts., is to be extended northward to Wall St. The addition is to be 24 stories high, faced with marble, and will be one of the most imposing buildings in the financial district. One of the top stories will be the home of a brokers' club, and the rest of the upper floors will be used as offices. The trading room or "board room," occupying the ground floor of the present building, is to be enlarged to include almost the whole area of the addition, three openings being cut in the wall between the two buildings for communication. The necessity of providing for this extension of the board room gave rise to the most interesting feature of the structural design, a group of exceptionally heavy trusses which carry the entire weight of the central portion of the building above ground. So far as the writer knows, these are the heaviest trusses ever used in office-building construction, and the columns supporting them are probably among the heaviest building columns ever designed.

Truss System of Support.—It was the architect's desire to make the extension of the board room an open space without columns, with a ceiling height of about 40 ft. Because of the importance of the lower floors, the trusses for carrying the structure over the board room had to be placed in the fifth story. These trusses, four in number, run north and south from columns on the Wall St. front of the addition to new columns just north of the old building. The third floor, forming the ceiling of the board-room extension, and the fourth floor, which forms a mezzanine in the third story, are hung from these trusses. The fifth and sixth floors frame into the bottom and top chords of the trusses respectively, the rest of the building standing on top of them.

As the plot is irregular the trusses vary in length, from 60 ft. 9¼ in. to 77 ft. 10⅛ in. c. to c. of supporting columns. Truss *C*, though not the longest, is the heaviest of the trusses, because the peculiarities of the various leaseholds which go to make up the plot necessitated designing that particular truss strong enough to carry a partition wall, should the owners desire to divide the building into two parts at the expiration of leases eighty-odd years hence. It weighs 165 tons, while the other three weigh about 150 tons each. Access to the different parts of the fifth story is obtained by doors or passages which go through the trusses between the diagonal members.

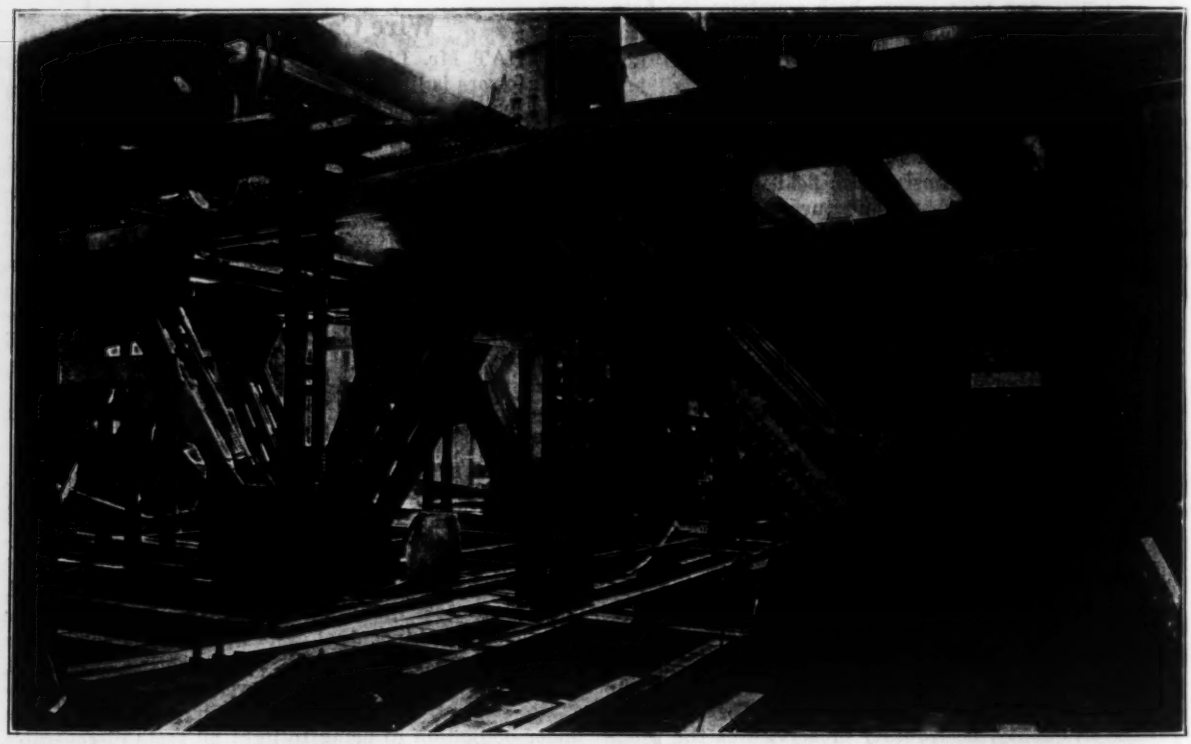


FIG. 1. HEAVY TRUSS CARRYING 21 STORIES OF STOCK EXCHANGE EXTENSION
Triple gusset of end joint at right; part of forked hanger at middle of truss at extreme left.

The depth of the trusses is 15 ft. 10 in. c. to c. of

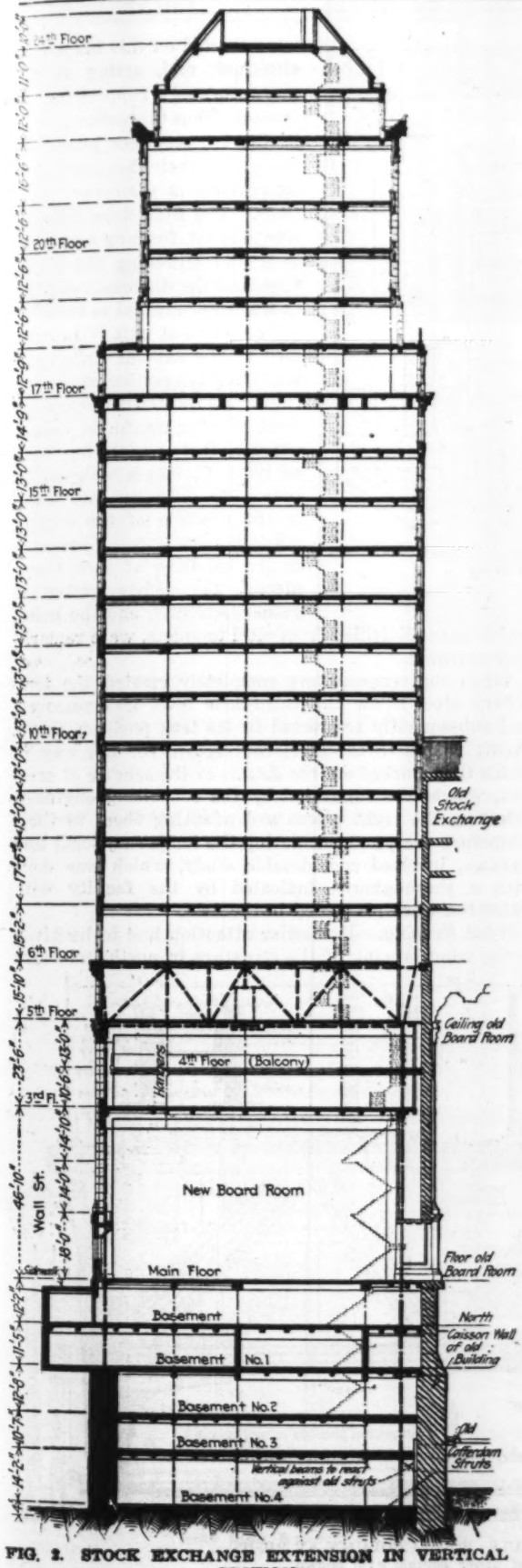


FIG. 2. STOCK EXCHANGE EXTENSION IN VERTICAL SECTION

chords. The calculated stresses run as high as 2,310 tons in the chords, while the heaviest diagonal has a stress of 2,480 tons. Column 13 receives the largest truss reaction, namely 2,406 tons, and the heaviest column load at the base is 2,556 tons. These large forces made necessary the design of particularly heavy built up sections for the columns and main truss members.

Truss Makeup and Joint Details.—There are many things that contribute to the engineering difficulties in a design of this kind. It was necessary to contend with the fact that the plot is of irregular shape, and further, is cut into several still more irregular pieces by property lines. Though having no relation to the design of the building as a whole, these lines had to be observed in order that legal difficulties might not arise due to encroachments and mutual dependencies, if the various owners should desire to separate when their present long leases expire. Then too, there is the great value of space in the financial district to be thought of. The structural work is continually being cramped to preserve architectural conditions, as a few more inches of headroom here, or a few more square feet of floor space there, are likely to be thought more desirable than the saving of steel through more economical design. Thus it was as the result of considerable study that the very compact riveted section used for the trusses and heavy columns, which made possible the design of a structure that would perform its functions within such dimensional limits, was developed. The problem of providing the heavy gusset-plate connections between the main members was a critical element in the design and the use of triple-thickness overlapping gusset plates interleaved with the plates of the columns and the truss chords furnished the solution, giving adequate strength of connection in the confined space available.

The columns and the main truss members are similar in design. In Fig. 4 is given a typical section of one of the members. The material is built up on a 14-in. 287½-lb. Bethlehem H-section, forming the web of the member, with three 24 x ¾-in. plates on each side, and angles and fillers as shown. This design lends itself to the use of the heavy gusset plates needed, which consist of one, two, or three thicknesses of ¾-in. plate replacing the 24-in. side plates of the members. They are stepped off, and compensating material is provided over the splicing points to preserve the required section throughout.

In order to carry the interior columns above without splicing to the trusses, which would have been complicated and taken up valuable floor space, the gusset plates at the truss panel points were extended slightly above the top-chord material and milled to form an accurate bearing. The milled ends of the columns above are seated directly on these milled bases, and angle clips or small plates are used to hold the columns in place. Wing plates on the column are used to develop the required bearing. The heaviest of these columns brings in a calculated concentration of 1,086 tons.

The size of the supporting columns, and more especially the spread of their foundations, made it necessary to keep them some distance back from the property lines, while the columns above the trusses are required to be nearer the building face. For this reason the end posts of the trusses are inclined outward, the end panels of the trusses thus forming cantilever extensions on which the wall columns above are supported.

The middle hanger for the third floor intersects the

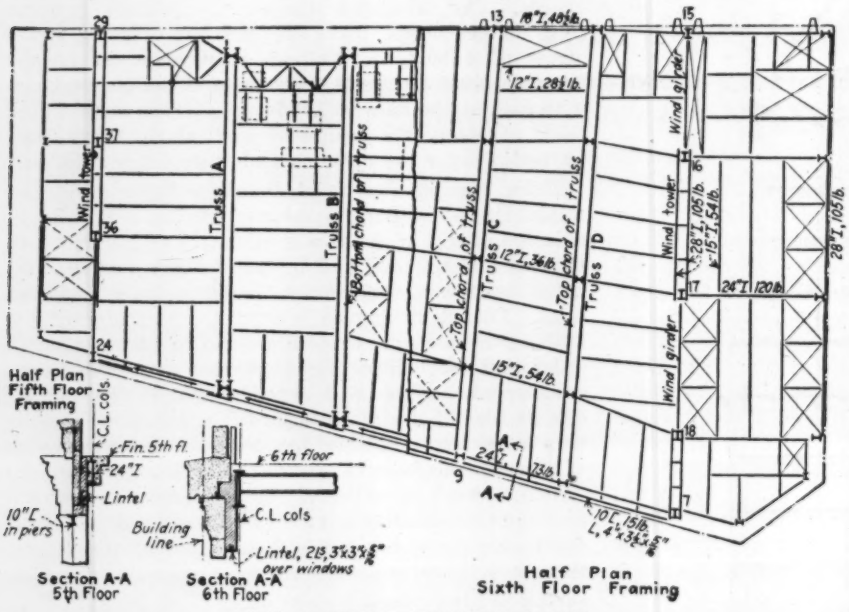


FIG. 3. TRUSS FRAMING PLANS

were erected on this temporary structure, and, acting as columns, formed a support for the trusses. Thus the bottom chords of the trusses were placed directly on their hanger splice connections in permanent positions. The fifth floor framing was then set, forming a working deck and stiffening the structure, and the diagonals and top chords were erected in turn.

The heaviest unit to be handled in the case of each truss was the main section of the top chord. Two 50-ton derricks were used, and the maximum weight lifted by them was the top chord of truss *C*, which weighed 53 tons. No difficulty was found in the erection of the trusses other than was to be expected in the handling of such heavy pieces. The members fitted together perfectly, and the holes, which were all drilled from steel templets, were remarkably accurate.

line of the passage in the fifth story. The upper end of this hanger was therefore forked as may be seen in Fig. 4, the passageway going through between its two arms.

All main truss connections were made with 1⅛-in. rivets, and the minor connections of other members in the truss have 1-in. rivets.

Erection of Heavy Trusses.—The erection of these trusses at such a height seemed likely to involve considerable expense in falsework, but the work was arranged in such a way that this expense was almost wholly eliminated. Steel columns, girders and beams intended for the upper part of the building were used in place of timber falsework up to the ceiling level of the board room; the hangers for the third and fourth floors

When the trusses were completely riveted the temporary steel below the third-floor level was removed, and subsequently re-erected in its true position above. Credit is due to the steel contractors for the way in which they worked out the details of the scheme of erection, which was suggested by the consulting engineer. Selecting the right pieces and adapting them to their temporary uses, and calculating the temporary loads and stresses, involved considerable study, which was done with a thoroughness indicated by the facility with which the work proceeded in the field.

Wind Bracing.—Particular attention had to be given to the wind bracing of the structure in north-and-south

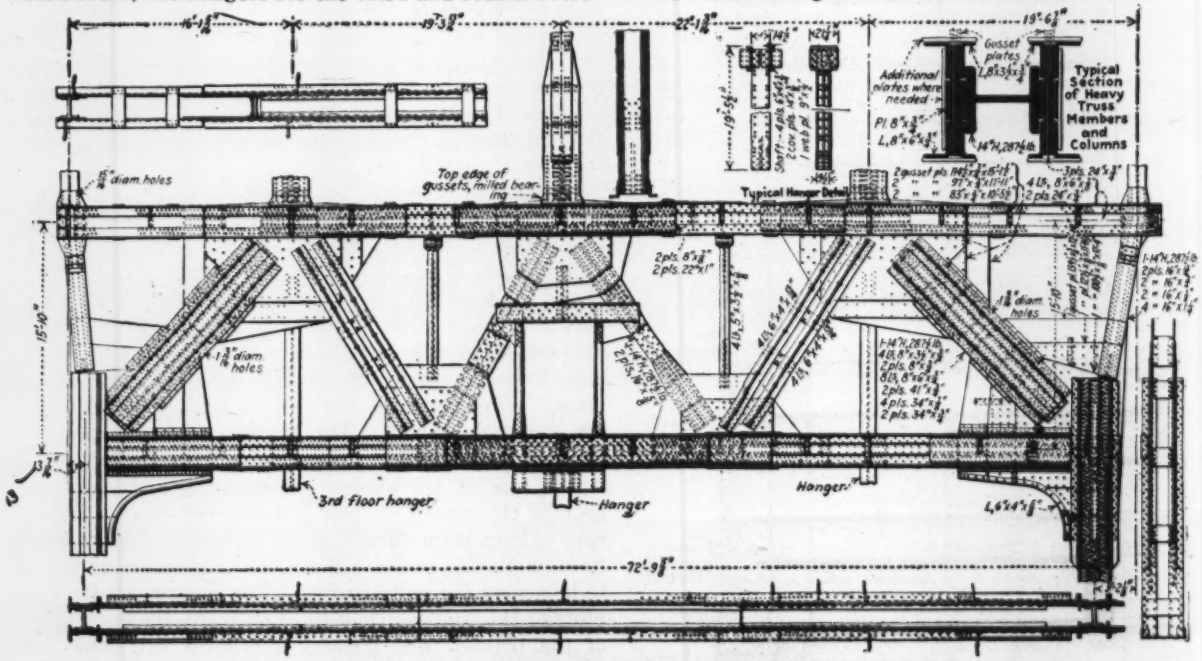


FIG. 4. DETAILS OF THE HEAVIEST TRUSS; SOUTH COLUMN AT RIGHT
Hanger detail and milled bearing of upper column also shown.

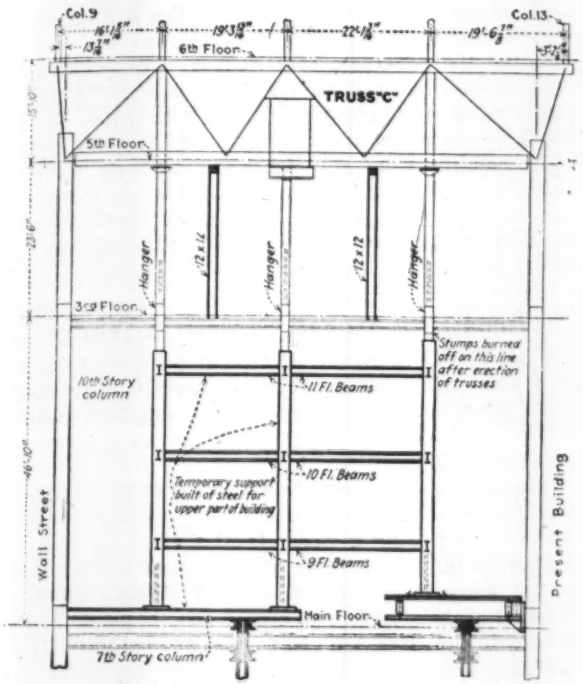


FIG. 5. UPPER-STORY STEEL USED AS FALSEWORK

location is accounted for by the offset at the eighth floor on the Broad St. front. At the west end there is no such offset, but the bracing could not be placed in the street wall because the floors directly adjoining the wall are so cut up by openings for elevators that they are not capable of transmitting the increment of shear from floor to wall.

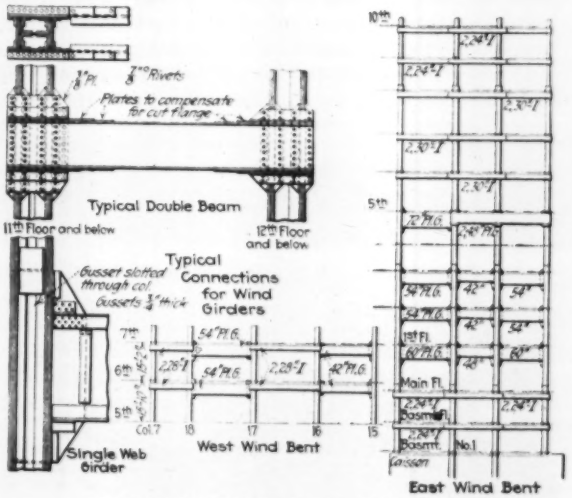


FIG. 6. WINDBRACING TYPES

direction. The central portion of the building having no interior columns in the lower stories, it was decided to make a stiffening bent of the four columns in the east or Broad St. wall (at ground level these columns are one bay west of Broad St.), and similarly of the five-column bent one bay from the west or New St. wall. The former

Both bents constitute rigid-joint square-panel frames with connections arranged within the depth of the girder as far as possible. Depending on architectural conditions, the horizontal members in these bents were designed either as single plate girders which connect to the columns by means of gusset plates slotted through

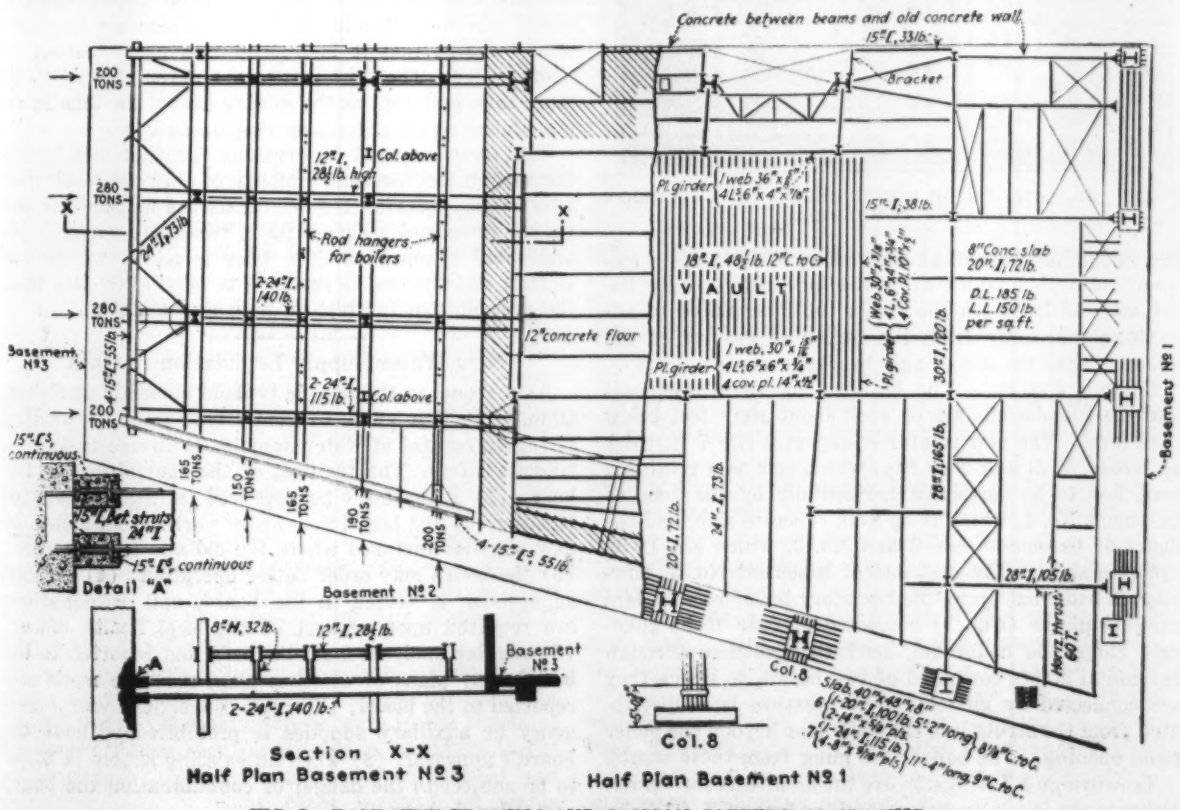


FIG. 7. BASEMENT FRAMING AND CAISSON COFFERDAM BRACING
This plan drawn to one-fifth larger scale than fifth and sixth floor plan, Fig. 3.

the column, or as double beams connected on either side of the column by means of angles (Fig. 6). The combination of moments caused by the wind, dead and live loads was calculated with great care and the connections designed accordingly.

An interesting detail occurs where the double beams connect to the interior columns of the wind towers. Owing to the fact that it is the *algebraic* sum of the separate girder moments which must be transmitted to the column, it was found best to run one pair of beams by a column to a point 3 ft. beyond the centerline, and there to splice to the next pair, developing in the splice

FIG. 8. FRAMEWORK OF STOCK EXCHANGE EXTENSION NEARLY COMPLETED

the calculated moment at that point. This made a column connection which projected but little outside the column and in which the rivets could be placed to advantage well away from the center of gravity of the group. Thus the use of ugly brackets was avoided.

Caisson Bracing.—The building has five basements and the foundations are on rock about sixty feet below curb level. The new reinforced-concrete rim 7 ft. thick on Broad, Wall and New Sts., which acts as a retaining wall, has to be supported horizontally by the floor of basement No. 1, which is an 8-in. concrete slab, and the floors of basements No. 2 and No. 3, which are 12-in. concrete slabs. The east end of basement No. 3, however, is badly cut up by the two-story boiler room. Here ranging pieces (Fig. 7) composed of four 15-in. channels along the cofferdam, send the pressure through horizontal struts composed of two beams, to which they are connected by gussets. The pressure is re-distributed from the struts into the solid floor beyond the boiler room opening. The boilers are hung from these struts.

Trowbridge & Livingston are the architects for the addition to the Stock Exchange, and the firm of S. C. Weiskopf designed the steel. Moran, Maurice & Proctor are the foundation engineers, who designed and superintended the cofferdam construction work, which was done by the Underpinning & Foundation Co. The building is being erected by Marc Eidlitz & Son, Inc. Levering & Garrigues are the contractors and erectors for the steel, and the work was fabricated at their plant at Dunellen, N. J. with the exception of the heavy columns and trusses, which were fabricated at the Bethlehem Steel Bridge Co. plant at Steelton, Pa. The total weight of the steelwork is about 5,660 tons.

Repairing Asphalt Streets in Winter

A METHOD of repairing asphalt pavements during the winter months, when municipal and county asphalt plants usually are closed down, has been evolved by Charles L. Harrison, engineer in charge of street repairs at Cincinnati.

The old asphalt pavement is removed from the streets and hauled to the yards during the regular working season, the pavement being broken down to approximately 2½ in. The heating plant consists of four horizontal four-wheeled kettles, each of 100-gal. capacity. The old asphalt, broken to proper size, is placed in the kettles in the afternoon and the fire started at 5 o'clock the next morning; 4 or 5 gal. of water are added and the covers are placed on the kettles. After being allowed to steam for half an hour the mixture is turned over with heavy bars, is spaded at one end and then allowed to steam again.

The operation is repeated until at the end of three hours the water has evaporated and the mixture is ready for use at a temperature of 325 to 375 deg. F. It is then transferred to another kettle, under which a hot fire has been built, and is hauled therein to the street where it is laid in the same manner as "new stuff," except that it is tamped into place instead of being rolled. The four kettles are never allowed to be more than half full, as the mixing cannot be done in an economical manner if the kettles are full.

The force engaged in breaking, heating and laying the asphalt in Cincinnati consists of only the seven men who are kept during the winter as the nucleus for the spring force and a driver for a two-horse wagon. No additional bitumen or dust filler is added to the old asphalt and the cost is reported to be slightly less than the average cost for repairs with new material.

New Water Supply Legislation in Ohio

As a sequel to the terrific typhoid epidemic at Salem, Ohio, in 1920, a law has recently been passed providing stringent control of water supplies to insure their continuous safety. The features of the control are as follows: (1) Plans must be approved by State Board of Health; (2) the board may order purification plants or new supplies installed where the old one is dangerous; (3) the board may order better operation; (4) general supervision is vested in the board, and examinations are required upon request of the local health officer; (5) regular analyses must be made and reported to the board; (6) plans of existing plant must be made and reported to the board; (7) cross-connections with emergency or auxiliary supplies is prohibited without the board's approval; (8) when an existing supply is found to be subject to the danger of contamination the board can order changes.

Dust Explosion and Collection in Grain Elevators

Difficult To Keep Elevators Clean—B. & O. R.R. Applies Dust Collection Equipment to Old Timber Elevators

THAT the dust explosion hazard is a factor in the structural design as well as the operation of grain elevators and certain other classes of industrial buildings has been shown clearly in articles on the wrecking of the Chicago elevator of the Chicago & Northwestern Ry. and on dust explosions in general, in *Engineering News-Record* of March 31 and April 14, pp. 560, 621 and 634. Many modern elevators, including the Chicago elevator, are provided with dust collecting equipment, but this deals only with dust produced in the handling of the grain within the building.

Rules made by certain grain authorities in regard to the operation of grain elevators prohibit the application of suction to the grain before it is weighed. In a paper read recently before the Western Society of Engineers, David J. Price, of the Bureau of Chemistry, U. S. Department of Agriculture, stated that for some time this Bureau has been recommending aspiration or the application of suction during the preliminary handling of the grain, in order to remove the dust before it has an opportunity to escape and accumulate in the elevator. He urged that the Northwestern explosion showed again the need for revision of this regulation.

The purpose of the prohibitory rule is to protect the shipper against reduction of weight of his shipment, but Mr. Price considered that safety to life and property demands its revision. He suggested that the shipper can be reimbursed for the dust and material removed, which has some value for cattle feed. Further, Mr. Price stated that where great quantities of grain are handled in a short time, the dust accumulates so fast that it is almost impossible to keep the elevator clean by ordinary methods of brushing and sweeping.

Baltimore & Ohio Elevators

An example of the application of dust collecting equipment to old elevators is afforded by the grain elevators of timber construction operated by the Baltimore & Ohio R. R. at its Locust Point terminal at Baltimore, Md. Early in 1920 it was decided to install a complete system for the collection and removal of dust in order to eliminate as far as possible the fire and explosion hazard and also to reduce the differential in fire insurance rates which applies to all grain handled through these elevators as compared with modern concrete structure. One elevator 100 x 330 ft., built in 1874, has a storage capacity of 1,200,000 bushels and is operated by the original installation of boilers, engine and line shafting. The other, 87 x 410 ft., built in 1881, has a storage capacity of 1,300,000 bushels and was converted to electric operation several years ago. In addition to the facilities for unloading grain from cars, each elevator has a marine leg with a capacity of 20,000 bushels per hour.

Besides installing the dust collecting system, it was considered desirable to include modern facilities for cleaning grain. The old cleaners were in the cupola of each house, where they constituted a considerable fire risk, were not readily accessible for adjustment and supervision, and in many cases involved an undue amount of handling of the grain. The new cleaner units are on the ground floor distributed so that as wide a range as possible can be served by each machine. In each house there are three machines having a capacity of 4,000 bushels per hour, fitted with sieves and screening brushes and operated by individual motors.

For collecting sweepings in each elevator, a complete sweeper system was installed, consisting of the usual equipment of fans, cyclones and galvanized iron pipe lines. Approximately one pick-up was provided for each 2,000 sq.ft. of floor space on the ground floor and all cupola floors. Discharge of dust from each cleaning machine is directly connected to the sweeper system through a cyclone for each individual cleaner. This sweeper system was designed to handle not only the dust but also the grain which necessarily collects on floor and is mixed with sweepings. Four fans for the sweeper system in the larger elevator discharge into a large cyclone which is located on the roof, directly over the dust bin. In the smaller elevator, dust collecting fans discharge into a small intake box, which is connected to a 6-in. underground pipe line leading to the dust room. Dust in this pipe line is handled by a blower in the dust house and is discharged directly into the dust bin.

Screenings which accumulate from each cleaner are collected in a small hopper under the floor, and are delivered to the dust house by a blower and 8-in. pipe lines. At the point of collection, bins are provided for the receiving and storage of screenings from each house. Screenings are then sacked and loaded into cars through a sack chute. Dust is loaded directly from the bin into box cars by a special screw conveyor, with an air blast for trimming dust in the car.

One man is required particularly for the operation of this system, his duties being the operation of machinery in the dust house and attending to the sacking and loading of screenings and dust. Operation of equipment throughout the elevators, including the sweeping of floors, cleaning of beams, etc., is handled entirely by the regular elevator force. The equipment was installed under the direction and supervision of L. P. Kimball, engineer of buildings, and T. H. Seal, superintendent of elevators, Baltimore & Ohio R. R. Stinson & Godfrey, Chicago, were the engineers and general contractors. The sweeper system and blow pipe work was installed by the Cyclone Blow Pipe Co., Chicago, and the "Airveyor" equipment was furnished by the Guarantee Construction Co., New York, as sub-contractor.

War Water-Works and Houses at Hopewell Sold

The 30,000,000-g.d. water-works plant built at Hopewell, Va., during the war to supply the munitions plant of the E. I. de Pont de Nemours Co. and adjacent villages has been sold by the Du Pont Chemical Co. to the Industrial Service Corporation of Virginia, which took possession Nov. 1. The works included pumping stations, filtration plant, and distribution system. The general manager of the purchaser is J. F. Muhlig, with headquarters at Hopewell. Recently the Du Pont Chemical Co. gave title to the last of the houses owned by it in one of the large villages in the Hopewell district. The transfer included 73 dwellings. Twenty firms have located at Hopewell since the movement to turn Hopewell and vicinity over to permanent industrial development was begun.

Experiences in Pneumatic Caisson Sinking in Mexico

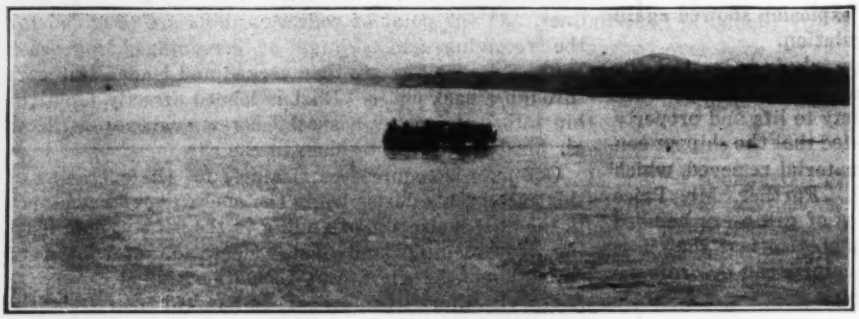
Bridge Pier Sunk 80 Ft. With Green Labor—Caisson Provided With Open Well for Dredging Simultaneous With Pneumatic Work

By T. Hind
Special Engineer, Southern Pacific R.R. Co. of Mexico, Tucson, Ariz.

NATIVE Mexican labor was successfully employed last year in the construction of a somewhat complicated foundation for a bridge for the Southern Pacific R.R. Co. of Mexico across the Fuerte River, a turbulent stream, in the State of Sinaloa on the west coast of Mexico. A special feature was the use of a pneumatic caisson and open well excavation in the same pier at the same time.

In the original construction of the railroad in 1906-1907 the river was crossed by a so-called temporary bridge consisting of 750 lin.ft. of pile and timber trestle and twelve 70-ft. steel deck plate girders on substantially constructed pile and timber piers, the girders being placed on the south side of the river over the deepest portion of the channel and the strongest currents. The structure averaged about 40 ft. high from normal low water to base of rail.

The original structure was satisfactory and gave no trouble until the winter of 1919, the highest floods in the meantime being about 20 ft. But on Jan. 2, 1919, the river rose to a height of nearly 35 ft. above normal low water, washed out four piers at the south end of the bridge and dropped five sets of the steel girders into the river, some of these girders weighing nearly 70,000 lb. They were carried downstream several miles by the force of the current.



LOCOMOTIVE CROSSING SHOO-FLY TRESTLE JUST BEFORE IT WASHED OUT

As conditions at the time were not favorable to undertaking expensive construction, it was decided to replace the washed-out portion of the bridge practically in kind, first reopening traffic on a temporary track and depressed trestle on a shoo-fly alignment.

Owing to the war-time conditions of the markets in the United States, from which practically all material and supplies had to be secured, work on the main bridge was considerably delayed. There was also additional delay owing to the fact that the summer and fall of 1919 were unusually wet and the river consequently high. For these reasons the main bridge was not ready for reopening traffic until the morning of Jan. 11, 1920, when the first revenue train passed over, at which time a rise in the river had already commenced. By 5 p.m. of the same day the flood had risen to practically the same extreme height of the flood of a year before, washed out three of the new piers and dropped four sets of girders, and washed out the greater portion of the shoo-fly trestle, which had already been washed out and replaced twice during the summer floods.

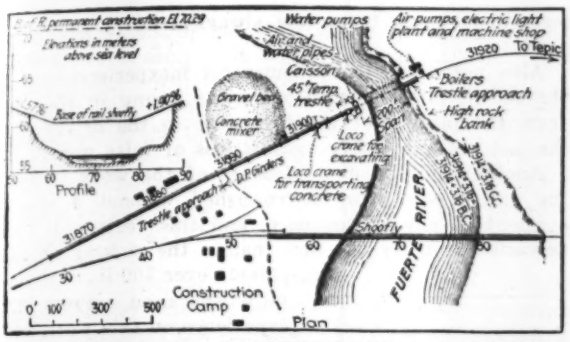
The floods both of 1919 and 1920 indicated scour in the river bottom of nearly 50 ft. to bedrock on the line of strongest current near the south end of the bridge and it seemed wise to span this region of greatest erosion with permanent construction. In view of the expensive maintenance of the shoo-fly trestle during flood periods it seemed wise to rush the work to completion before the summer floods.

A 350-ft. steel span would have been ideal for the situation but structural steel was still unreasonably high priced and quick delivery impossible to secure, so a 200-ft. span which the company already had in stock was decided on.

There was a good bedrock location for a pier to support the south end of this span practically at the south edge of the river but soundings for the pier at the north end indicated a necessary penetration of slightly over 40 ft. through sand, gravel, and large quantities of heavy riprap to a sloping surface of bedrock, into which there would have to be a penetration of 8 ft. on the north side of the pier in order to provide a proper bearing. The pneumatic caisson method of sinking seemed advisable. An effort was made to have the pier constructed by contract but various proposals from contractors were not satisfactory, and the unusual course of undertaking pneumatic caisson construction with the everyday working forces of the company was adopted; traffic, in the meantime, being again opened over the replaced shoo-fly trestle.

Together with the construction of the 200-ft. span with its necessary piers, some rearrangement of the remaining portion of the bridge was necessary in order to properly close the washout gap, the entire work consisting of one 200-ft. pin connected through truss of span, two 60-ft. deck plate girders, a short timber trestle, an ordinary concrete pier, a pneumatic caisson pier and one pile pier, with piling driven to bedrock.

Sounding for bedrock, designing, and the selection and purchasing of equipment and materials consumed a great deal of time, but by April 1 considerable material and some equipment was on the ground and actual work commenced. On April 3 all transportation on the company's lines was tied up by a general strike of train and engine men and simultaneously began the revolution which ousted President Carranza. The forces at the bridge were completely isolated from the outside world until April 26, when traffic was again reopened



PLAN AND PROFILE OF FUERTE RIVER BRIDGE SITE

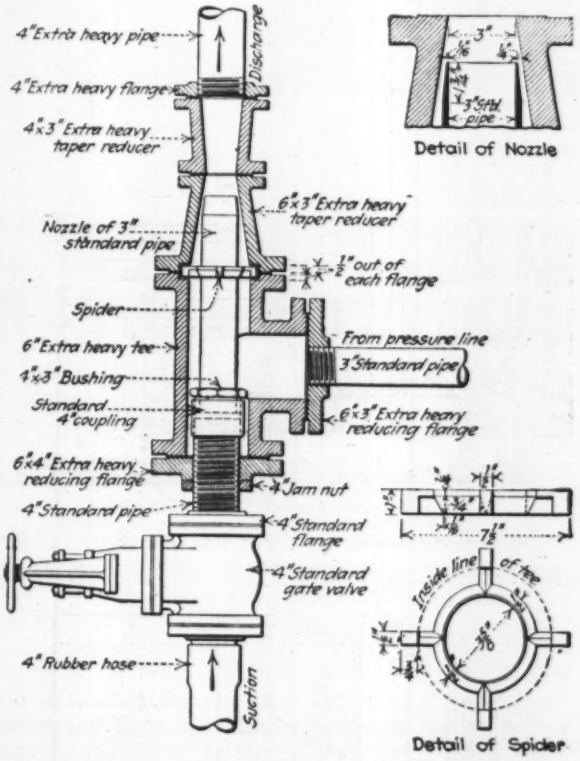
over the company's lines, only to find that, owing to the switchmen's strike in the United States, necessary equipment and materials were tied up all over the United States with very indefinite prospects of delivery.

Under these circumstances it seemed wise to abandon the idea of sinking the caisson before the summer floods, but a small force was continued on preliminary work, constructing camp buildings, the concrete pier at the south end of the 200-ft. span, and the pile pier north of the pneumatic caisson pier, the framing of the wooden shoe of the caisson, and the partial assembly of the power plant.

During the summer, floods were not sufficiently high to again wash out the shoo-fly trestle, and work on the main structure was recommenced about Oct. 1. Sinking of the caisson was commenced Oct. 20.

The pier sunk by pneumatic caisson consisted of concrete reinforced with old rails and with 36 in. of wooden shoe to cushion shocks of blasting, the cutting edge of the wooden shoe being reinforced with 8-in. channel irons. Facts regarding its design and construction may be tabulated as follows:

Horizontal dimension of caisson	20x50 ft.
Height of air chamber	9 ft.
Thickness of concrete ceiling poured before commencing sinking	6 ft.
Age of concrete in caisson at time sinking commenced	4 to 6 days
Penetration of caisson shoe below base of rail	79 ft. 3 in.
Penetration of concrete below caisson shoe	3 ft. 6 in., max.
Total penetration of pier below base of rail	82 ft. 9 in.
Total penetration of caisson in sand, gravel, riprap and solid rock	42 ft. 5 in.
Total penetration of caisson below normal low water surface	42 ft. 5 in.
Net Excavation	
Sand	543 cu.yd.
Gravel	526 cu.yd.
Heavy riprap	241 cu.yd.
Solid rock	165 cu.yd.
Concrete in pier	1,535 cu.yd.
Total lumber permanently in place in caisson and pier	49,000 ft.b.m.
Reinforcement	40 tons, 40 lb. relay rails and 4,080 lb. twisted steel.
Total hardware, inclusive of various shafts, forgings, bolts, etc	30,500 lb.
Chronological Data	
Shoe of caisson placed in position	Oct. 10
Commenced sinking	Oct. 20
Sinking completed	Dec. 3.
Air chamber filled with concrete	Dec. 6.
Pier completed	Dec. 15.
Progress	
Average rate of sinking in sand and fine gravel	3 ft. 7 in. per day.
Average rate of sinking in boulder gravel	1 ft. 10 in. per day.
Average rate of sinking in rip rap and solid rock	5½ in. per day.
Principal Equipment	
2—125 hp. stationary boilers.	
3—Straight line steam-driven air compressors total capacity	942 cu.ft. per min.
3—Heavypressure duplex steam pumps	10x6x12 in.
2—4-in. hydraulic ejectors.	
1—Steam driven 9 kw. electric light plant.	
1—Portable 180 amp. hour gasoline driven storage battery. Electric light plant.	
2—Locomotive cranes—10-ton and 20-ton capacity.	
1—Orangepeel bucket, ½cu.yd.capacity.	
1—½-yd. batch concrete mixer, complete with boiler and engine.	
1—Track pile driver.	
Schedule of Wages	
Common labor on surface	$1.25 per day
Handy labor on surface	1 75 per day.
Carpenters on surface	2 25 per day.
Sandhogs, first 10-ft. penetration	2 25 per day.
Sand hogs, second 10-ft. penetration	2 50 per day.
Sand hogs, third 10-ft. penetration	2 75 per day.
Sand hogs, fourth 10-ft. penetration	3 00 per day.
Foremen, stationary engineers, etc	$125 to $150 per month with board.



HYDRAULIC SAND EJECTOR USED IN FUERTE RIVER BRIDGE

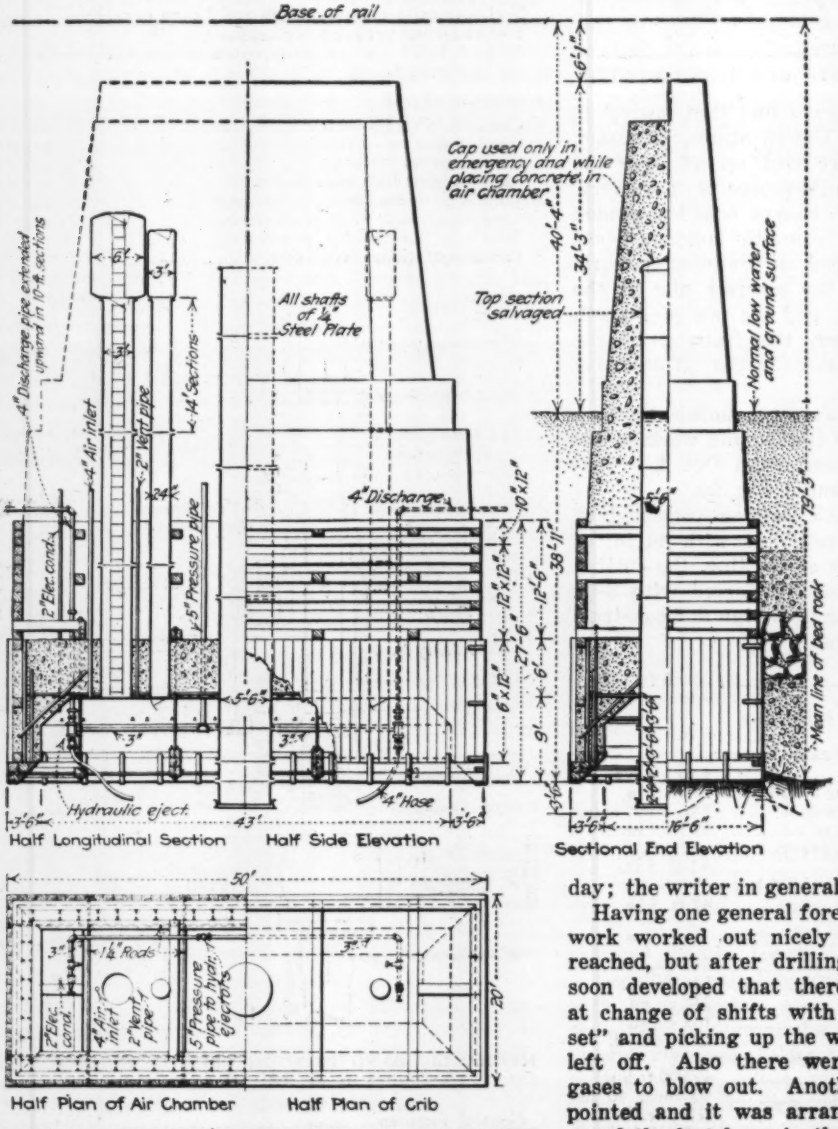
General foremen	$200 to $225 per month with board.
Blacksmiths, machinists, etc	$3 to $5 per day.

Working time—8 hours per day (4 hours on and 8 hours off) for sand hogs and machine men actually engaged in sinking caisson, and 10 hours per day for others.

All common laborers, sand hogs, mechanics, clerks, and foremen, also the master mechanic and two general foremen were native Mexicans. They were absolutely inexperienced in pneumatic caisson work and steel bridge erection. In fact, there were only three men on the rolls in addition to the writer who had ever

seen a pneumatic caisson, and these three had to be discharged very early in the game because of Bolsheviki tendencies. From laborer to general foremen they were resourceful and faithful and soon caught on, not only to the practice but also to the principles and theory of what they were doing. They also worked much more steadily than it is generally supposed that Mexican workers do.

In quantity performance the writer believes that, considering all the conditions, good results were obtained.


Base of rail
Cap used only in emergency and while placing concrete in air chamber
All shafts of ¼" Steel Plate
Top section salvaged
Normal low water and ground surface
4" Discharge pipe entrated upward in 10-ft. sections
4" Air inlet
2" Vent pipe
14' Sections
2" Elec. cond.
5" Pressure pipe
4" Discharge
Main line of bed rock
Hydraulic eject.
4" Hose
Half Longitudinal Section
Half Side Elevation
Sectional End Elevation
Half Plan of Air Chamber
Half Plan of Crib

DETAILS OF PNEUMATIC CAISSON BUILT AND OPERATED BY MEXICAN LABOR

The riprap and solid rock through which the caisson was sunk were very difficult and the difficulties were increased by the thick strata of very open gravel penetrated. In sinking through the upper stratum of sand there was no difficulty in keeping the water surface from 6 in. to 12 in. below the cutting edge of the caisson, but after the open gravel was reached it was impossible to lower the water surface more than an inch or two below the highest point of the cutting edge, and at the least disturbance there was always a heavy inflow of sand.

Also, not a bad performance for inexperienced men, the 200-ft. pin connected span was swung in 13 days from the placing of the first seat to the driving of the last pin and safety against loss of false work.

Another quite unusual feature of the work is that the entire work was accomplished without a single accident of any consequence, and this feature is not detracted from by the fact that in the sinking of the caisson over 700 lb. of dynamite was used. From his experience on this work and on other work, the writer believes that the Mexican people are capable of quite high industrial development if proper general conditions can be secured in their country.

The supervising organization might by some be criticised as topheavy and unnecessarily expensive, but it must be remembered that inexperienced men were doing work of quite special nature. During the sinking of the caisson there was a master mechanic in general charge of the power plant, 24 hr. per day; three general foremen on the surface, 8 hr. each per day; one general foreman in charge of air chamber work, on duty 24 hr. per day in case of emergency, but in routine putting in two hours in the air chamber with each gang of sand hogs; three sand-hog foremen and three sub-foremen, 8 hr. per day; one concrete and general purpose foreman on the surface, 10 hr. per day; the writer in general charge with no specific hours.

Having one general foreman in charge of air chamber work worked out nicely until the heavy riprap was reached, but after drilling and blasting commenced it soon developed that there was too much lost motion at change of shifts with the incoming gang "getting set" and picking up the work where the outgoing gang left off. Also there were blasts to fire and powder gases to blow out. Another general foreman was appointed and it was arranged that a general foreman spend the last hour in the air chamber with each outgoing shift and the first hour with each incoming shift. The results were good. Ten sand hogs working four hours on and eight hours off were worked in each of the three air chamber gangs until the heavy riprap was reached and afterwards as many as could be packed into the air lock, an average of from twenty to twenty-five.

As the season in which the caisson was sunk was not one of positive low water, plans for the prosecution of the work had to be based on the possibility of floods of medium extent.

The main power plant was located on the high solid

rock south bank of the river above the reach of any possible flood, the pumps being placed at the foot of the bank in such a way that flooding would not damage. A 4-in. air line from the air compressors and a 5-in. water line from the pumps were carried across the river channel to the location of the pier on floats, 40 ft. of the air line being looped below the water surface for cooling purposes. Connection of air and water between the pipe lines and the caisson were made with links of fire hose.

From the remaining northern portion of the bridge, falsework was extended as a work track to the location of the pier. On the extreme end of this falsework a locomotive crane was placed to handle the dredging, etc.

The concrete mixer was placed in the bed of the river about 300 ft. to the north and alongside of the bridge both for the purpose of being above probable flood waters and of being convenient to a good bed of gravel. The mixer was served by another locomotive crane which also transported the mixed concrete in a bottom dump bucket dumping it into a hopper in the track behind the dredging crane. From this hopper the concrete flowed under the dredging crane in a galvanized iron chute to the caisson.

The wooden shoe of the caisson had been framed and assembled on the north bank of the river about 400 yd. distant from the location of the pier the previous spring. In the fall when work was commenced there was about 5 ft. of water at the pier location. The location was enclosed by a slip constructed of timber, piling, brush, and wire to protect against floods, and filled to the water surface partly by silting and partly by dredging and the caisson shoe was skidded to place.

The necessary forms, outside 6 x 12-in. sheeting, various shafts, and piping were placed after the timber shoe was landed and concrete poured to a depth of 6 ft. above the ceiling of the air chamber, a very rich mixture, 6 sacks of cement to the cubic yard of river gravel being used to a height of 12 in. above the ceiling, and above this an ordinary mixture of 4 sacks to the yard was used.

Four days after the completion of the pouring of the concrete to the 6-ft. line sinking was commenced; perhaps a rather risky procedure as the concrete was very green, but no harm resulted.

The construction of the caisson was very satisfactory. Usual preparations were made in advance to stop leaks when air pressure was first turned on but there were no leaks either at this time or subsequently.

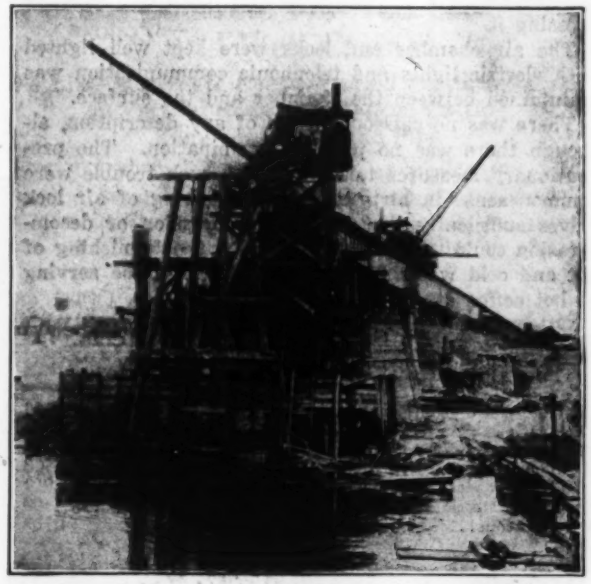
The removal of excavated material from the air chamber was accomplished by hydraulic ejectors or sand pumps by blowing out with air and by dredging with an orange-peel bucket through an open shaft or water column 5 ft. 6 in. in diameter. All the methods worked satisfactorily.

The hydraulic ejectors were, to the best of the writer's knowledge, original in design, being constructed practically altogether by the assembly of ordinary commercial pipe fittings. No attempt was made to determine their actual capacity, but with the water-supply at from 90 to 100 lb. pressure they ejected all the sand or gravel that could be fed to them and without any trouble except an occasional plugging with material too large to go through.

At about 20 ft. penetration the material became too coarse for the ejectors; the nozzles, etc., were removed and the same hose and ejector pipes were used to blow material through with air. Even in the heavy riprap and solid rock these air guns were of good service, considerable quantities of accumulating spalls, gravel, and sand being ejected through them.

The orange-peel bucket in the open dredging shaft or water column was effective in every way. Rocks of several cubic feet contents were grappled and removed. When rocks too large to be thus removed, or solid rock, was encountered at the bottom of the shaft, it was broken, either by blasting, if this seemed the most convenient way, or by dropping a rock breaker through the shaft from above.

The rock breaker was a small box girder bridge seat built up of four extra heavy 10-in. I-beams with miscellaneous web and cover plates, the whole securely riveted together. By manipulating it the same as a



WORKING ON THE CAISSON OF THE FUERTE RIVER BRIDGE

pile-driver hammer through the dredging shaft, with the locomotive crane above, quite large rocks could be quickly broken if they were loose or detached, but it was too light to have much effect on solid rock.

The bottom of the dredging shaft extended 2 ft. 6 in. below the cutting edge of the caisson so as to provide leeway in case material encountered should prove sufficiently tight to enable the water surface to be held conveniently below the shoe of the caisson, but if working again in material so open as that encountered actually proved to be, the writer would not extend the shaft more than perhaps a foot or, at the most, a foot and a half below.

Blasting in the air chamber was done by drilling, by snakeholing in crevices, and by driving loaded 1¼-in. pipe in seams. The heaviest single charge placed was 3 lb. of 40 per cent dynamite and the heaviest blast consisting of a series of holes eleven pounds. Firing was done by a blasting battery located in the air lock, the lower door of the lock being closed but the pressure not equalized.

In the first 30 ft. penetration no difficulty from skin friction was encountered and it was never necessary to reduce air pressure. At this point the caisson become

badly bound in rock and very drastic reduction was necessary for all penetration secured until sinking was finally completed. Pressure was reduced at each shift change, the general air chamber foreman on duty at the time throwing both 4-in. ejector pipes and a 2-in. ventilation pipe wide open and blowing down to 3 or 4 lb. pressure. At this stage of reduction the air chamber would be filled with water to within 3 or 4 ft. of the ceiling, but when the valves were closed and the three compressors started full force the chamber would be unwatered by the time the incoming shift had reached the bottom. This blowing out also served to clear the air of powder smoke.

The highest air pressure used in actual sinking was 18 lb., but in filling the air chamber with concrete as high as 31 lb. was used for the purpose both of crowding the concrete under the cutting edge and of compressing it.

The air chamber and locks were kept well lighted with electric lights and telephonic communication was maintained between the chamber and the surface.

There was no caisson disease of any description, although there was no physical examination. The precautionary measures taken to avoid such trouble were common sense in hiring men, the bushing of air lock valves sufficiently that neither compression or decompression could take place too rapidly, the furnishing of hot and cold water bathing facilities, and the serving of hot coffee at each change of shift.

Cost of Work

The estimated cost of the work was as follows:

Concrete pier on south side of river	$4,893
Pneumatic caisson pier	79,579
Pile pier north of caisson pier	7,374
200-ft. pin connected truss span, complete with track	25,508
2-60 ft. deck plate girders, complete with track	5,950
Permanent trestle	300
Miscellaneous	4,763
Total	$128,359

In the light of the comparatively cheap labor prices involved the substructure costs may seem high, but cheapness did not extend to equipment, materials, and supplies. As typical samples, cement cost approximately $5.50 per bbl., f.o.b., at the river, and coal cost $10 per ton. The steel superstructure units were, however, in stock prior to the development of war bridge prices, and were charged out to the work at about 3c. per lb.

The work was handled under the general direction of the late Epes Randolph, president, and L. H. Long, vice-president, of the company, with the writer in direct charge of design and construction. W. E. Schley, Division Engineer of the Sonora Division, served as chief assistant and rendered very valuable services.

Oxygen Consumed Varies with Concentration Cornell Investigation Shows

After an elaborate set of tests at Cornell University on the recommended method of determining the oxygen consumed in sewage and other heavy concentrations it has been found that the amount indicated in dilution varies with the strength, being greater for the weaker solutions. However, the variation is in accordance with mathematical formulae which John Scacciaferro worked out and reported in the October *Cornell Civil Engineer.*

Cement Stucco Covering for Small Railway Buildings

A CHEAP and durable type of construction for houses of section foremen and laborers and for small stations and office buildings, which has been developed on the Nashville, Chattanooga & St. Louis Ry., consists of a wood frame sheathed with wire mesh over or woven with, building paper and covered with 1 in. of stucco appiled by the cement gun process. Fig. 1 shows the general construction for section houses, some of the details being given in Fig. 2.

Composition red shingles on ½-in. tongued and grooved sheathing cover the roof. Ceilings and inside walls are of ½-in. pine ceiling or of plaster on electrically welded lathing. At the corners of all openings the stucco is reinforced by sheets of the wire mesh, with paper removed, these sheets being placed diagonally, as shown. The wire mesh often used is electrically welded, with building paper between the woof and warp, the latter being placed next to the studding. In some cases, tarred felt has been used, being tacked in place before the wire

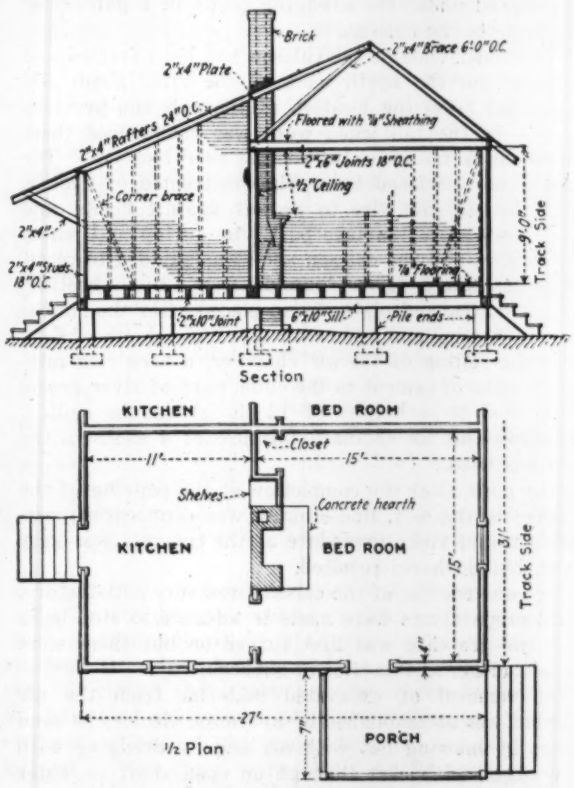


FIG. 1. SECTION LABORERS' HOUSES OF STUCCO ON WIRE MESH AND WOOD FRAME

mesh is applied. Wood trim with which wet stucco will come in contact is first given two coats of paint to prevent swelling and subsequent shrinkage cracks. Outside trim is painted brown, with window sash black, the interior being light buff. All painting is three-coat work.

The section laborers' buildings are for two families, with a kitchen and bedroom for each, the bedroom having a brick fireplace and concrete hearth and the kitchen having a stove flue. About 75 per cent of the track laborers are negroes. A four-room house for the section

foreman is built on the same general plan, but with doors provided in the two interior partition walls, one porch being omitted and two of the doors replaced with windows.

Similar construction has been used for two-story buildings for storehouses and yard offices, but these have usually plank storm sheathing, over which paper or felt and wire mesh are applied on furring. A stucco covering has been applied also to old frame and brick buildings, the brick being cleaned with wire brushes or

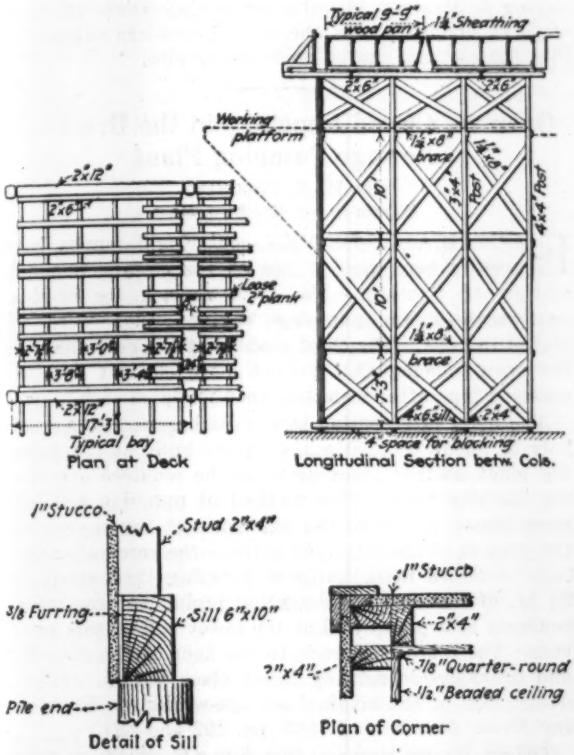


FIG. 2. DETAILS OF HOUSE WITH STUCCO COVERING

by sand blasting with the cement gun. Old section houses of boxing and batten construction have been successfully coated with the stucco. In doing this, the battens are first removed and all exterior trim is adapted to the stucco treatment, inserting nailing grounds where needed. The paper backed wire mesh is applied with fence staples, the staples not being driven clear home in order that the stucco may get a grip behind the wires.

The 1:3 mixture of cement and sand is passed through a ½-in. screen, moderately coarse and slightly damp sand being preferable to very fine dry sand. Pressures of 35 lb. of air at the gun and 50 lb. of water at the nozzle are recommended in the railway company's instructions, the water supply being regulated to give a plastic mixture that will remain on the wall without flowing or sloughing. The nozzle is held usually about 3 or 4 ft. from the wall.

Two coats of stucco are applied, preferably with an interval of not more than half an hour between them. The first ¾-in. coat (½-in. on old buildings) is screeded to a plane surface and then a ¼-in. second or "flash" coat is applied for a smooth finish. While the latter is still wet, it is brushed lightly with a wet whitewash brush, to secure uniform color and texture, the stucco being then kept sprinkled for two or three days. Corner and frieze boards, steps and similar parts are applied to grounds in the stucco after it has set.

With present prices and conditions, the cost of a double section house complete is about $2,700. If the exterior walls were of pine drop-siding, with three coats of paint, the saving would be only $125, and there would be the expense of painting at intervals of four or five years. As the stucco requires no such maintenance, it shows a real economy. There is little trouble from cracking or spalling of the stucco, if it is properly applied. This style of building construction and repair, begun in 1914, has been developed gradually under the direction of Hunter McDonald, chief engineer of the Nashville, Chattanooga & St. Louis Ry., the work being done by the forces of the engineering department.

Porous Concrete for Well Strainers and Well Casing

No Fine Aggregate Used—Precast Sections Strung on Vertical Rods with Bottom Cutting Edge—Interior Sand Pipe

CONCRETE of high porosity as a substitute for the usual brass well strainer and steel casing is a new development for water supply wells in gravel and sand formations which has been applied in several cases for depths up to 130 ft. A porosity of about 22 per cent in volume is obtained by removing all sand from the aggregate, the concrete being a 1:4 mix

FIG. 1. POROUS CONCRETE FOR WELL STRAINER

made with gravel screened to reject all material retained on a No. 5 screen and all that passing through a No. 12. Typical crushing strengths are 1,110, 1,626 and 2,633 lb. per square inch for ages of 7 and 28 days and 2 months respectively. The appearance of the concrete is shown in Fig. 1.

This well casing, Fig. 2, is made in 48-in. lengths reinforced with ¼-in. steel rings and having eight 1¼-in. pipes for vertical rods or bolts. The bearing surfaces are mortised and are put together with 1:3 cement mortar. With an internal diameter of 36 in. and a wall thickness of 5 in. the 4-ft. section has a weight of 1,523 lb. and gives an external area of 37.7 sq.ft. Its porosity permits a flow of about 10 gal. per minute per square foot of external surface. There is said to be less clogging or choking of sand around the concrete than around a brass strainer, so that there is less diminution of flow with age.

To sink a concrete-lined well, a 40-in. riveted steel

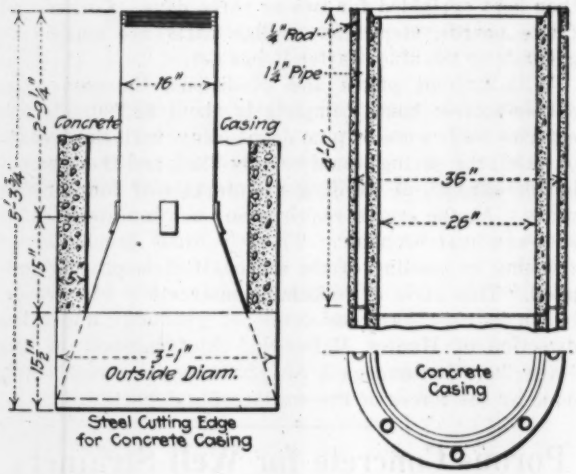


FIG. 2. CONCRETE WELL CASING AND STEEL CUTTING EDGE

casing with Z-bar cutting edge, Fig. 3, is driven down to the water bearing stratum, the casing being suspended in a steel derrick frame and the inclosed material being excavated by an auger or sand pump. Into this casing the porous concrete lining is lowered, as in Fig. 4, the bottom section resting on and being bolted to a funnel-shaped cutting edge (see Figs. 2 and 3). To the smaller end of this funnel is screwed a 16-in. pipe which serves to lower the casing and in which the sand-bucket excavator operates. This method of working protects the concrete from abrasion or injury by the bucket.

When five sections have been lowered, the sand is pumped out, causing the concrete casing to sink. Additional sections are placed and the operation is repeated until the desired depth is reached. Then the temporary steel shell is withdrawn, the bottom of the well is sealed with concrete, and finally the 16-in. pipe is cut off near the cutting edge and pulled up.

FIG 3. STEEL SHELL FOR CONCRETE WELL

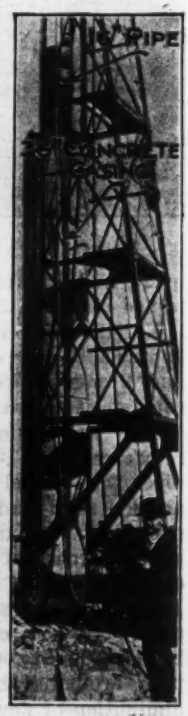


FIG. 4. CONCRETE CASING

Greater rate of flow and more permanent flow are claimed as advantages over brass strainers, the low velocity of the water due to the large inlet area causing little movement of fine sand towards the well. In a recent well the velocity to and through the strainer was only 2.125 in. per minute. This porous concrete well casing is patented and is manufactured by the Well Casing & Strainer Manufacturing Co., Alton, Ill. For work at distant points the steel forms are shipped so that the sections can be made at the site.

Open vs. Closed Impellers in the Brockton Sewage Pumping Plant

By H. S. CROCKER,
City Engineer, Brockton, Mass.

ELECTRICALLY-DRIVEN centrifugal pumps have recently been put in use at the sewage pumping station of Brockton, Mass., to replace the original equipment—steam pumping engines—that were installed in 1894. The chief feature of the new pumps is the open impeller that proved more efficient than the enclosed type after tests had been made on each.

The main intercepting sewer discharges into a reservoir of about 500,000 gal. capacity built at the pumping plant, so that pumping would be required only during the day time. This method of pumping has long since lapsed owing to the extension of the sewers and the growth of the city. At present the reservoir serves only to afford more uniform pumping throughout the 24 hr. of the day. The suction piping for the pumps connects at a pump well at the lower end of this reservoir. There is little grade to the floor of the structure and considerable settling takes place within. (For a description of the original sewage-works see *Engineering News*, first half of 1895, pp. 292 and 334.)

Originally there were two 5-m.g.d. steam pumping engines, designed to raise 5,000,000 gal. of sewage in 24 hr. to a height of 46 ft. through 16,650 ft. of 24-in. cast-iron force main to the disposal works.

As time progressed the steam pumping plant became more and more inefficient, partly due to age and partly due to the fact that with the building of the sprinkling filter plant it became necessary to elevate the sewage 16 ft. higher; and of course the friction head had slightly increased during this time. Good judgment required that it be replaced by a more modern plant.

Estimates prepared by the writer in September, 1917, for electricity, oil and steam as motive power showed that the installation of electrically-driven centrifugal pumps would be cheapest not only as far as first cost was concerned but also when considering maintenance. The Sewerage Commission therefore decided to ask for bids for this type of a plant.

The specifications required that three electric motors directly connected to centrifugal pumps be furnished; one unit to lift 2,000,000 gal. and each of the other two units to lift 3,500,000 gal. of sewage 62 ft. through 14,650 ft. of 24-in. pipe in 24 hr. to the disposal plant. The length of force main was decreased 2,000 ft. at the time of the construction of the sprinkling filters. Synchronous motors were specified for the larger sizes because the local Edison Co. offered an extra 10 per cent

discount from its bills if this type of motor was installed for sizes of 75 hp. or over. The type of equipment as well as efficiencies were left to the bidders. The contract stated, however, that tests for capacity and efficiency of the units would be run both at the factory and at Brockton after being erected, before acceptance.

Bids were received and the contract was awarded in December, 1917, to the Power Equipment Co., of Boston, whose bid of $12,750 was the most satisfactory one for the city. Its efficiency guarantees were as follows: the small pump, 72 per cent; the larger pumps, 73; overall of small unit, 64; overall of larger units, 66 per cent. The temperature-rise guarantee above room temperature for the motors was 50 deg. C. on the synchronous motors and 40 deg. C. on the squirrel-cage motors.

Pump and Motor Specifications

The pumps were manufactured by the DeLaval Steam Turbine Co., Trenton, N. J. They are of single-stage, double-suction, single-impeller type. The small pump is 8 in. in size and is designed to run at 1,750 r.p.m. The two larger pumps are 10 in. in size and their speed is 1,200 r.p.m. The pumps are of such design that they can readily be dis-assembled, and all parts can be inspected without disturbing the suction or discharge pipe connections. The impellers, as originally furnished, were of the enclosed type, but since the first test they have been replaced by open type ones. Each pump was originally provided with special patented sewage wearing rings, dividing the suction and discharge chambers. They are designed to eliminate wear, and are arranged to be self cleaning, and to prevent stoppage in the impellers. A special form of stationary cast-iron sleeve surrounding the rotating sleeve, locked into the pump casing at one end and butting the impeller at the other end, is furnished to prevent winding of strings, rags, etc., around the shaft. These pumps are directly connected by flexible couplings to motors manufactured by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The small pump is driven by a 40-hp. squirrel-cage induction motor, and the larger pumps by rotating-field synchronous motors, each having a full load of 75 hp. when impressed with 3-phase, 60-cycle, a.c. at approximately 2,200 volts. These two motors have a 1.25-kw., 125-volt direct-connected exciters for furnishing exciting current when running. The motors are started and brought to approximate synchronous speed as induction motors. When this speed is attained, the auto-transformers are cut out and full line voltage is impressed on the stator, the exciter is connected to the rotor windings and the motors fall into synchronism.

The plant was put into operation in May, 1919. It was to have been tested immediately or as soon as the 500,000-gal. receiving reservoir was cleaned—that is, the sludge pumped out so that the pumps could be tested to maximum lift. This reservoir served in a dual capacity—both as a regulator of the sewage flow so that pumping could be at a uniform rate and als served as a partial settling basin. The new pumps could not raise the sludge 17 to 18 ft. although it was well diluted with water. The contractor thereupon started experimenting with an open-type impeller in order to accomplish the work that the enclosed impellers could not do. Before a suitable one was shipped to Brockton a year had passed by without the reservoir being cleaned once.

This new impeller was installed on Jan. 5, 1920, and after experimenting with it for a week the real cleaning began. It lasted until the thirtieth of the month, at which time all sludge had been removed. The sludge contained quantities of sand, cotton waste, grease, etc. It was broken up by the incoming sewage and also by hydrant streams, and flowed to the pump well at about the consistency of oatmeal. Men were continuously raking the bar screen between the reservoir and the pump well, and during the cleaning period removed from the screen 58 cu.yd. of material. This was a small part of the actual sludge, which was estimated at 1,000 cu.yd.

Acceptance tests were conducted on these pumps on April 21, 22, and 23. Each pump was tested twice—first taking the sewage directly from the main sewer, protected only by the bar screen; and second, taking the settled sewage from the reservoir. The pumps failed to pass test in either output or efficiency, as shown in the following table:

Unit	Gallons Delivered per Minute		Per Cent of Overall Efficiency	
	Contract	Test	Contract	Test
1	2,450	2,380	66	59.5
2	1,400	1,240	64	47.5
3	2,450	2,410	66	58.5

The test on Unit 1 was connected with the open impeller instead of the enclosed or contract impeller.

The contractor claimed that the failure to come up to guarantee was the result of the hard usage the pumps received during the year before the test, and especially during the cleaning of the reservoir. Owing to the fact that the pumps had performed so satisfactorily—pumping water—in the shop tests at Trenton, the contractor was granted another chance with new impellers to prove that the pumps could do the work. The Power Equipment Co. was satisfied that the larger waterways of the open-type impeller were necessary to do the work, especially as the Pump 1 had been tested with the open impeller, and they, therefore, requested that the DeLaval Co. make the open-type impellers. Work was immediately started on the design of the new impellers. They were installed in January, 1921, and acceptance tests were conducted in February. Through a misunderstanding the Venturi meter was not calibrated previous to the tests, but as no adjustments had to be made to it when calibrated before the previous tests this work was waived until afterwards and tests were conducted. This was unfortunate as after tests the Venturi people did not calibrate but adjusted the meter. The actual readings of the meter were therefore not as reliable as had been expected. The figures of the last test are accordingly not absolutely reliable:

Unit	Gallons Delivered per Minute		Per Cent of Overall Efficiency	
	Contract	Test	Contract	Test
1	2,450	2,695	66	65.1
2	1,400	1,240	64	53.3
3	2,450	2,710	66	64.8

These figures show that the pumps exceeded the output requirements by a considerable margin and that the efficiencies of the units were very close to contract guarantees.

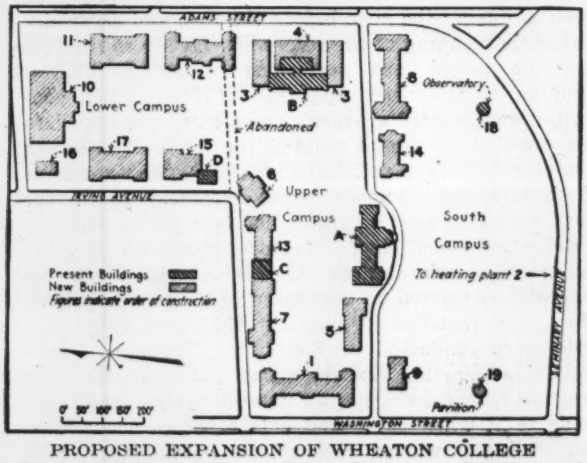
There is absolutely no comparison between the two types of impellers for small high-speed pumps as far as sewage work is concerned. The open impeller pumped far more liquid in the final test than did the closed impeller even in the shop tests at Trenton. And as seen

by the figures, there is no comparison in the efficiencies. The contractors made the claim that wear was the cause of the inefficiencies in the 1920 tests. There is no doubt that there was considerable wear but the real work and the real wear was not on the closed impeller of Pumps 2 and 3 but on the open impeller of Pump 1, which was designed only for high suction lift with a heavy material to pump. Regardless of that fact, its output in the 1920 tests was only 30 gal. short of the closed impeller and the overall efficiency of that unit was a whole per cent higher. Strange as it may seem, there is no doubt as far as pumping Brockton's sewage is concerned—even when that sewage is settled and very dilute—but that an open-type impeller properly designed will give a greater output and a higher efficiency than the enclosed one for small high-speed pumps even when the impellers are new.

Program for 20-Year Expansion of Small College

Engineering Department to be Established and Several New Buildings Erected at Total Cost of $2,680,000

A PROPOSED expansion of Wheaton Congregational College at Wheaton, Ill., has been planned on a comprehensive program extending over a term of 20 years in order that the completed institution may be harmonious in the style and arrangement of its buildings and facilities. An engineering department is to be



PROPOSED EXPANSION OF WHEATON COLLEGE

Present buildings: A, Main building; B, women's dormitory and dining hall; C, gymnasium (to be taken down); D, academy (to be moved).

New buildings: 1, Men's dormitory; 2, heating plant; 3, additions to women's dormitory; 4, dining hall; 5, history and English; 6, library; 7, men's dormitory (first section); 8, women's dormitory; 9, administration; 10, gymnasium; 11, science; 12, women's dormitory; 13, men's dormitory (second section); 14, chapel; 15, academy; 16, hospital; 17, engineering.

added as part of the expansion. This program calls for the expenditure of about $2,680,000.

Wheaton college, founded in 1848, has at present a four-story main building 75 x 190 ft., a women's dormitory, a gymnasium and an academy for preparatory students. At the rear of this last is a heating plant which serves all the buildings. The first two structures shown in black on the accompanying plan, will be retained, although remodeling of the main building is included in the program. New buildings of the proposed scheme are shown by hatched areas.

From a study of the growth of the institution it was concluded that in 20 years the number of students would be 1,200, if the necessary facilities were made available. A somewhat higher capacity would be provided by the instructional buildings as planned, but the dormitories would accommodate only about 900, as a certain number of students live at home or in private residences. The main building is on the crest of a slope toward the south, and as there is plenty of room toward the north, this slope is to be left practically undisturbed. All the buildings are to front on a large interior space comprising the present campus and a new campus, the latter being within two blocks of the present athletic grounds. A new heating plant would be located on the low ground adjacent to the Chicago & Northwestern Ry. For the new buildings, an English gothic style of architecture is proposed, the structures to be of reinforced concrete, with brick and stone walls and tile or slate roofs. The present main building is of buff stone and the dormitory is of red brick.

PROPOSED BUILDINGS FOR WHEATON COLLEGE

Building	Size, Feet	Stories	Cubic Feet	Cost
1. Men's dormitory No. 1	235 x 90	3	612,800	$270,700
2. Heating plant	$125,000 for first unit, total			235,000
3. Wings on women's hall	115 x 40	3	441,600	198,800
4. Dining hall	115 x 70	1	241,500	85,000
5. History and English	127 x 47	2*	243,700	97,500
6. Library	74 x 54	2	95,200	57,000
7. Men's dorm. No. 2 (first sec.)	190 x 45	3	391,200	177,000
8. Women's dormitory No. 2	200 x 90	3	552,000	248,500
9. Administration building	75 x 45	2	135,000	61,000
10. Gymnasium	170 x 84	2	662,400	200,000
11. Science hall	136 x 82	2	428,800	171,500
12. Women's dormitory No. 3	170 x 90	3	480,000	216,000
13. Men's dormitory, add. to No. 2	160 x 45	3	320,000	143,000
14. Chapel	60 x120	1	380,000	190,000
15. Academy building	92 x 47	2*	181,000	72,500
16. Infirmary (move old academy and remodel)	.....	...	.....	15,000
17. Engineering hall	136 x 82	2	428,800	171,500
18. Observatory	.....	..	.....	20,000
19. Pavilion	.....	..	.....	10,000
20. Grounds	.....	..	.....	30,000
21. Remodeling main building	.....	..	.....	10,000
Total				$2,680,000

*No basement.

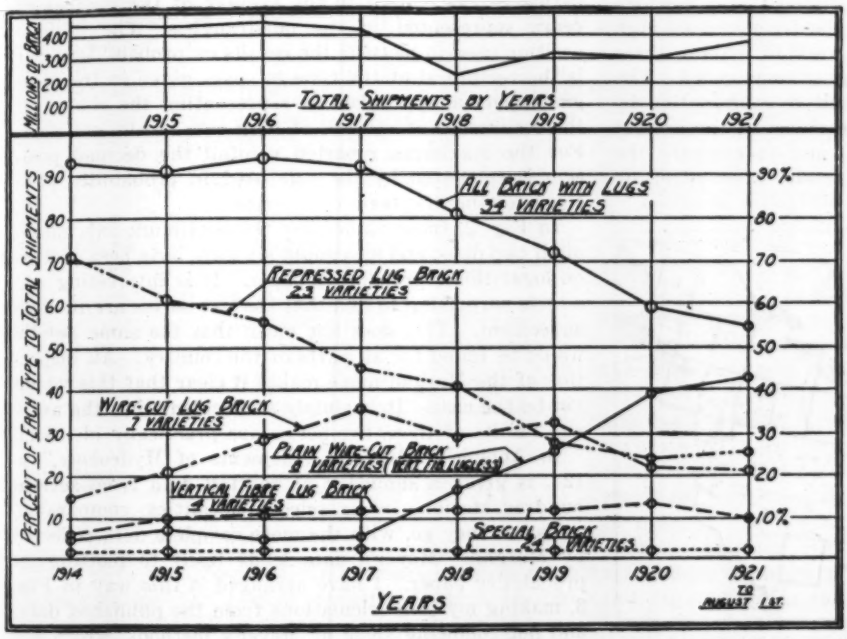
Figures noted on the plan indicate the order in which the buildings would be constructed, but no dates are set as the progress would depend upon financial conditions and the growth of the institution. The sizes and estimated costs of the several structures are noted in the accompanying table. This program of enlargement has been worked out by Wolf, Sexton, Harper & Truax, engineers and architects, Chicago. Dr. C. A. Blanchard is president of Wheaton College.

Tie Shortage on Indian Railways

The problem of maintaining the supply of ties in India, both for renewals and for new construction, is becoming more acute every year, according to the report of the Railway Department for the year 1919-1920. As supplies of native hardwood that can be used without treatment are limited experiments are encouraged with ties of various materials in order to develop substitutes that will be satisfactory under the conditions of Indian railways. A creosoting plant is being built for treating native soft woods, its capacity being 300,000 ties annually, but completion of the plant has been delayed considerably. Several types of reinforced-concrete ties are on trial, but most of these are still in the experimental stage. Pressed steel trough ties and cast iron ties consisting of pairs of bowls or plates connected by tie bars are used extensively, the latter forming a type of track construction distinctive of the Indian railways but used also in South America.

Many Varieties of Paving Brick Shown by Survey

IN RECOMMENDING the adoption of only 11 varieties of vitrified paving brick, in place of the 66 varieties which have been on the market from 1914 to date, representatives of paving brick manufacturers and engineering societies, who met in Washington, D. C., Nov. 15, with officials of the Department of Commerce, as noted in the news section of this journal Nov. 17, p. 831, based their conclusions largely upon a comprehensive report of a variety survey in the vitrified paving-brick industry made by the National Paving Brick Manufacturers Association for the U. S. Department of Commerce. A summary of the report follows:



VARIETY TREND OF PAVING BRICK SHIPMENTS, 1914-1921 (AUG. 1)

In the shipment of 66 varieties of vitrified paving brick from 1914 to 1921 there were five major divisions of type, each with a variable number of sizes included as follows: (1) Plain wire-cut brick (vertical fiber lugless), 8 varieties; (2) repressed lug brick, 23 varieties; (3) special brick, 24 varieties; (4) vertical fiber lug brick, 4 varieties; (5) wire-cut lug brick (Dunn patent), 7 varieties. Each size of product, according to its type, is designated as a variety in the report.

The classification in Table I demonstrates the trend and status of variety according to type of brick, this year's figures being as of Aug. 1.

TABLE I. VARIETIES OF PAVING BRICK SINCE YEAR 1914

Type of Brick	'14	'15	'16	'17	'18	'19	'20	'21
Plain wire-cut (v.f. lugless)	5	6	7	7	6	7	5	6
Repressed lug	16	18	20	20	18	16	15	14
Specials	15	12	16	12	14	16	11	7
Vertical fiber lug	4	4	4	4	4	3	2	2
Wire-cut lug (Dunn)	3	3	5	5	5	5	7	7
	43	43	52	46	47	47	40	36

The data in the report are based upon replies from 44 companies operating 64 plants in 16 states. The total annual tonnage of brick produced is normally 4,245,300, or approximately 90 per cent of the total productive capacity of the entire industry.

The position of each type of brick during each year since 1914 is shown in Table 2, in which "1" signifies the brick in highest proportion, "2" the next highest, and so on to the lowest which is "5." In general the distribution of types shows that up to and including

TABLE II. TYPES OF BRICK CLASSIFIED IN ORDER OF PRODUCTION VOLUME

Type of Brick	'14	'15	'16	'17	'18	'19	'20	'21
Plain wire-cut brick (v. f. lugless)	4th	4	4	4	3	3	1	1
Repressed lug brick	1st	1	1	1	1	2	2	2
Special brick	5th	5	5	5	5	5	5	5
Vertical fiber lug brick	3rd	3	3	3	4	4	4	4
Wire-cut lug (brick (Dunn)	2nd	2	2	2	2	1	3	3

1918 the pre-dominant brick was of the repressed type with lugs. In 1919 the wire-cut lug brick had the ascendancy, closely followed, however, by repressed lug brick and plain wire-cut brick. In 1920 and 1921 the plain wire-cut brick is the predominating type.

An analysis of each type of brick by sizes indicates that two sizes stand out predominantly; they are 3½ x 4 x 8½ in., and 3 x 4 x 8½ in. In 1921 these two sizes constituted 83.1 per cent of all brick shipped; the 1921 shipments were about equally divided between the two prevailing sizes.

A sharp upward trend of the combined shipments of the two prevailing sizes of brick began in 1918 and reflects a tendency toward simplification of variety, following the wartime depression of industry. As the quantity of shipments has increased the proportions of the 2 sizes and 10 varieties has grown at the expense of the remaining 56 varieties shown in the report.

Cores Taken from New Jersey Roads Aid Research

Cores obtained by drilling through the pavements of New Jersey highways, according to R. B. Gage, chemical engineer of the state highway department, indicate the wisdom of not permitting the coarse and fine aggregate to be dumped on the sub-grade. Evidently a great deal more of this sub-grade material got mixed with the aggregates during handling than was thought possible. This sub-grade material, Mr. Gage points out, frequently is very deleterious. The effect of permitting concrete to be dumped on a muddy, soft sub-base has also been noticed in the samples taken. Irregularity in the contour of the sub-base is shown quite plainly by the cores; there is a variation in height of nearly 4 in. The borings also will be utilized as a means of studying drainage conditions of the sub-base.

The Frequency of High Rates of Rainfall

A Probability-Method Study of Data for the Eastern and Middle Western States in Morgan's Miami Technical Reports, Part V, and Meyer's "Elements of Hydrology"

BY ALLEN HAZEN,
Civil Engineer, New York City

ARTHUR E. MORGAN, Chief Engineer of the Miami Conservancy District, Ohio, has collected data for high rates of rainfall in the eastern part of the United States. (Part V, Miami Technical Reports.) All the records of the U. S. Weather Bureau were brought into a series of tables and diagrams showing the rain-producing capacity of the climate in every part of the eastern United States. Apparently this is the first time that these splendid data have been examined in a comprehensive way to learn from them the frequency of high rates of rainfall. Mr. Morgan's work in making these results available cannot be too highly commended. The data are in a form that lends itself to examination by graphic probability methods. The object of the present study is to apply such methods, and to compare the results so reached with similar results from carefully collected but less extensive data otherwise available.

FIG. 1. MAP SHOWING LOCATION OF RAINFALL QUADRANGLES

In the Morgan report the data are summarized by quadrangles of latitude and longitude, extending two degrees in each direction. All of the data for each quadrangle are combined as if they formed a single record, and results taken from this combined record are shown in figures printed upon the maps of the Miami report. To study average relations between time intervals and varying degrees of rainfall intensity, a limited number of quadrangles were selected. The basis of the selection was to take those that had the most numerous data. All quadrangles showing over 500 years were first taken. There are 28 such quadrangles. (See map, Fig. 1.)

TABLE I. INCHES OF RAINFALL IN SELECTED QUADRANGLES

Twenty-eight Quadrangles	Decimal Position	Maximum Day	Maximum Two Days	Maximum Three Days	Maximum Four Days	Maximum Five Days	Maximum Six Days
Once in 15 yr.	0.0667	4.15	4.98	5.43	5.79	6.17	6.42
Once in 25 yr.	0.04	4.73	5.63	6.21	6.57	6.91	7.20
Once in 50 yr.	0.02	5.43	6.35	7.03	7.45	7.84	8.19
Once in 100 yr.	0.01	6.14	7.44	8.12	8.62	8.94	9.23
Maximum in record.	0.00071	9.21	10.36	10.80	11.67	11.86	12.60
Six Quadrangles							
Once in 15 yr.	0.0667	4.02	4.88	5.08	5.38	5.68	5.90
Once in 25 yr.	0.04	4.67	5.63	6.05	6.35	6.60	6.90
Once in 50 yr.	0.02	5.25	6.18	6.88	7.22	7.60	8.00
Once in 100 yr.	0.01	6.10	7.30	7.97	8.40	8.70	8.90
Maximum in record.	0.00064	9.10	11.10	12.20	12.90	13.00	13.30

The data from these 28 quadrangles were then summarized. A like summary was made for the six North Atlantic quadrangles covering New England, except Maine, southern New York, eastern Pennsylvania, New Jersey, and parts of Maryland and Delaware (Fig. 1). The results of this study (Table I) show first the amount of rainfall in inches to be expected for the maximum day in 15, 25, 50 and 100 years, and in the period corresponding to the average of the number of years represented in the quadrangles. The decimal position used in plotting the results on probability paper is the reciprocal of the time in years given in the Morgan report and is taken as representing the chance of the occurrence of rainfall of high rate in any one year. For the maximum reported rainfall the decimal position is computed by the rule used in probability plottings for the first term of a series.

In Fig. 2, these values for the maximum day, maximum two days, and maximum six days have been plotted on logarithmic probability paper. It is interesting and a little surprising to find that the two series are in close agreement. This does not mean that the same results would be found for all parts of the country. An inspection of the Morgan maps makes it clear that this would not be the case. It is simply an accident that the average results of these two series are practically identical.

In Adolph F. Meyer's "Elements of Hydrology," p. 124, is given a summary of rainfall data from several hundred stations in six selected localities, comparable, as far as they go, with the more complete data collected by Morgan. Meyer's data lends itself to plotting on probability paper. I have arranged it this way in Fig. 3, making my own calculations from the published data, and not following some of Meyer's methods, which are not appropriate for this purpose. Table II shows the numerical values corresponding to the plotting and also the rates of precipitation to be equaled or exceeded once in 10 years and once in 100 years, scaled from the plotting. These values may be compared with Morgan's. In Fig. 31 of the Miami report are shown the maximum 24-hr. precipitations to be expected once in 100 years, in all parts of the eastern United States. I have taken from this approximate values corresponding to Meyer's districts. The corresponding figures side by side are shown in Table III. The check between

TABLE II. MEYER RAINFALL DATA FOR HIGH RATIO OF RAINFALL IN SIX DISTRICTS (See Fig. 3)

	Alabama	Minnesota	Ohio	Eastern Kansas	Central Kansas	Western Kansas
No. of stations	65	72	100	42	38	26
No. of years	15	20.75	15	15	15	15
Station years	975	1,490	1,500	630	570	390
Ratio of number of daily precipitations above limit to number of years in record:						
9 in.	0.0031	0.0013	.....	.....	.....	.....
8 in.	0.0082	0.0027	.....	.....	.....	.....
7 in.	0.0205	0.0047	0.0020	0.0095	0.0017	0.0025
6 in.	0.0440	0.0087	0.0047	0.0223	0.0035	0.0077
5 in.	0.1080	0.0161	0.0080	0.0650	0.0175	0.0205
4 in.	0.3400	0.0605	0.0340	0.1560	0.0750	0.0665
3 in.	1.0200	0.2250	0.1530	0.4950	0.2700	0.1590
2 in.	3.8800	0.9650	0.8800	1.9600	1.2300	0.6850
1 in.	15.8000	5.4000	6.9500	8.7500	6.4500	4.0500
Once in—						
10 yr., in.,	5.1	3.6	3.3	4.5	3.8	3.5
100 yr., in.,	7.8	5.7	4.8	6.9	5.4	5.7

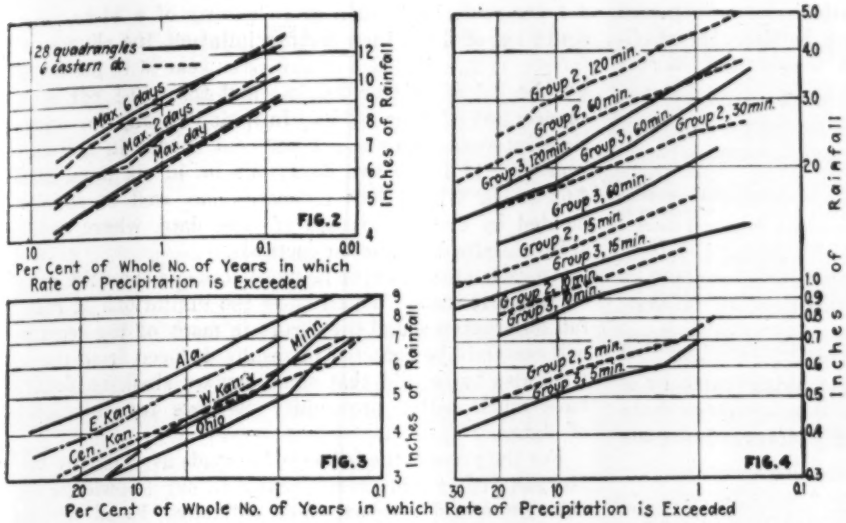


FIG. 2. COMPARISON OF HIGH RAINFALLS IN THE 28 AND THE 6 QUADRANGLES
FIG. 3. HIGH RAINFALLS FOR ALABAMA, OHIO, KANSAS AND MINNESOTA, PLOTTED FROM MEYER DATA
FIG. 4. MEYER RAINFALL DATA PLOTTED BY INTENSITY GROUPS

Meyer's and Morgan's values for the same districts is close. On an average Morgan's values are 3 per cent higher. The agreement is satisfactory and adds confidence to the use of the data.

TABLE III. COMPARISON OF MEYER AND MORGAN DATA

District	Daily Precipitations in Inches Equaled or Exceeded Once in 100 Years	
	Meyer	Morgan
Minnesota	5.7	5.5
Ohio	4.8	5.3
Eastern Kansas	6.9	7.5
Western Kansas	5.7	5.5
Central Kansas	5.4	5.6
Alabama	7.8	8.0
Average	6.0	6.2

There have been frequent compilations of high rates of precipitation for periods ranging from 5 to 120 minutes. Charles W. Sherman's article on the 26-year record at Springfield, Mass., *Engineering News-Record*, Sept. 2, 1920, p. 445, and Kenneth Allen's analyses of New York data, *Engineering News-Record*, April 7, 1921, p. 588, and H. P. Eddy's figures in the *Journal* of the Boston Society Civil Engineers, February, 1921, may be mentioned.

Meyer in his Hydrology, p. 144, attempts a general classification of this kind of data in groups, according to the intensities of precipitation at the various stations. His work may be compared with Morgan's, though the data used are much less numerous. His map on p. 151 of his book shows the classification of the country into groups. This resembles in a way Morgan's Fig. 31, showing the maximum 24-hr. precipitation to be expected in 100 years.

Meyer's Groups 2 and 3 cover, in a general way, that part of the country corresponding to the 28 quadrangles. In Fig. 4 are plotted Meyer's data for these groups, showing the rates of precipitation to be expected in 5, 10, 15, 30, 60 and 120 minutes. Solid lines are used for Group 3, and broken lines for Group 2.

In Fig. 5 I have brought together Morgan's data for the 28 quadrangles and Meyer's data for short periods of intense precipitation, using values intermediate between those found for Group 2 and Group 3, and to those I have added figures for annual and monthly rainfall based on 45 in. mean. This plotting is logarithmic in both directions. On it have been drawn lines showing the rates of precipitation at which there is one chance in 10, one in 100, one in 1,000, and one in 10,000 of being exceeded in one year. The last one (or two) values were obtained by extending the appropriate lines of the preceding figures on logarithmic probability paper. These indicated extreme values are to be taken only as rough approximations but perhaps give a better idea than is otherwise available as to the probable occurrence of extreme rates. All of the values shown by this and the preceding diagrams relate to probable precipitations at one observation station. They must not be taken as applying to considerable areas, because precipitations are not the same even at stations a short distance apart. The probable precipitation on any considerable area will be less than that at a particular station.

The marked variation in the direction of the lines in the different parts of their course suggests that there are certain periods in rainstorms. Very heavy intensities last, at most, from one to two hours. It is unfortunate that we do not have 4- and 8-hr. records for comparison; but the maximum day's rainfall is only 50 per cent greater than the corresponding 2-hr. rainfall. It seems that the hardest rainfalls usually work themselves out in a 2-hr. period, and only moderate rates are to be expected immediately before and after.

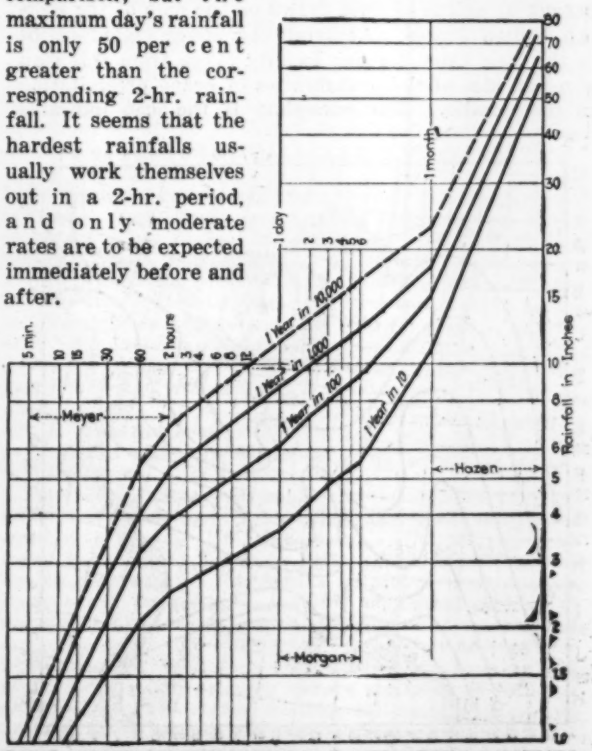


FIG. 5. COMPARISONS OF MORGAN AND MEYER RAINFALL INTENSITY DATA, WITH ADDITION OF ANNUAL AND MONTHLY RAINFALLS BASED ON 45-IN. MEAN

Some interesting and useful ratios may be obtained from these data. These ratios are between the maximum precipitations occurring in longer and shorter periods of years, and also during varying numbers of minutes, hours and days. All the data are very consistent in these ratios and only the average results are here given, in Tables IV and V.

TABLE IV. RATIOS OF AMOUNTS OF PRECIPITATIONS IN EQUAL TIME INTERVALS OF DIFFERENT DEGREES OF PROBABILITY

	Morgan's Data 1 to 6 Days	Meyer's Data 5 Minutes to 2 Hours
10% chance in any one year	0.60	0.70
1% chance in any one year, taken as starting point for computing ratios	1.00	1.00
0.1% chance in any one year	1.45	(1.32*)
0.01% chance in any one year	(2.00*)	(1.68*)

* Extrapolation beyond limits of actual data.

TABLE V. RATIOS OF MAXIMUM PRECIPITATIONS OF EQUAL PROBABILITY IN VARIOUS TIME INTERVALS

Calculated for 1 percent chance in any one year, but approximately applicable to other degrees of probability

6 days	1.48	From Morgan's data
5 days	1.42	From Morgan's data
4 days	1.36	From Morgan's data
3 days	1.29	From Morgan's data
2 days	1.19	From Morgan's data
1 day	1.00	Basis
12 hr	0.88	Interpolated from logarithmic plotting
6 hr	0.77	Interpolated from logarithmic plotting
3 hr	0.69	Interpolated from logarithmic plotting
2 hr	0.64	Combination of Morgan's & Meyer's data
1 hr	0.50	Combination of Morgan's & Meyer's data

These ratios may be applied directly to the value found for any locality by an examination of Morgan's Fig. 31 (here reproduced as Fig. 6). This shows the maximum 24-hr. precipitation to be expected in a 100-yr. period, by means of lines drawn on the map of the eastern United States. Applying the above stated ratios to the base value for any locality taken from this map gives an idea of the probabilities of heavy precipitation in that locality. For example: If the map indicates a 1 per cent chance at a given locality of a 24-hr. precipitation of 6 in., then the precipitation, the chance of the occurrence of which in any given year is 10 per cent, will be 0.6 of this or 3.6 in.; and for a 0.1 per cent chance 1.45 of it or 8.7 in. In a similar way for other time intervals there is a 1 per cent chance in any one year of 7.14 in. in two days; 8.9 in. in six days, and 4.62 in. in 6 hr. Such estimates may well be supplemented by detailed studies of local data, where available, examined by similar methods.

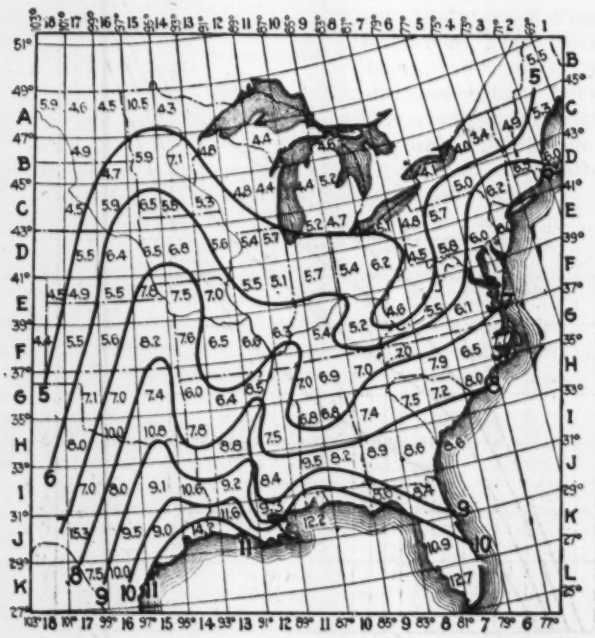


FIG. 6. MORGAN'S 100-YEAR EXPECTATIONS OF 24-HOUR PRECIPITATION FOR THE EASTERN UNITED STATES

An estimate can never be more accurate than the data on which it rests. We all know the limitations of rainfall observations, and the errors in many of the records will certainly be reflected in results deduced from them. It is also to be said that some day we shall, no doubt, have much better probability methods for this kind of data.

For the present the information made available by the Morgan report adds very greatly to our knowledge on this important subject; and estimates based on it, though by no means precise, may be useful in many undertakings.

Electrification of Logging Equipment In the Pacific Northwest

The electrification of logging railroads and the substitution of electric yarders and loaders for steam donkeys working in the woods is a subject of general discussion in the lumber industry of the Pacific Northwest and a few electrical installations have been made. Factors to be considered in making changes of this sort were reviewed in a paper by E. J. Barry, electrical engineer, Tacoma, Wash., presented at the recent Pacific Logging Congress at San Francisco. The following has been abstracted from his paper:

One of the principal advantages of electricity in logging operations is in the fuel saving. Refuse from the sawmill will supply all the power required in a logging operation at a cost much below that which would be entailed in developing the same power with fuel oil, coal or wood. Unlike the steam engine, motors require no water and the colder the weather the better operating conditions become; these are distinct advantages in many parts of the woods. As compared to steam power, the greater hauling capacity and higher speeds of electric locomotives makes it possible to render the same service with less number of locomotives and hence fewer train crews.

After experiment with single-phase and three-phase alternating current, the present practice favors high voltage direct current. Reasons for this are (1) that direct current gives good speed control with easy acceleration, (2) it can be used for regenerative control, that is, the motors of a locomotive on the down grade act as generators to pump energy back into the line, and (3) direct current can be used for dynamic braking with great saving in wear of brake shoes, wheel faces and rails.

The electric locomotive requires much less in upkeep than does the steam locomotive and will operate for at least twice the mileage without requiring overhauling in the shop. The saving in operating costs of electric over steam railroads would be from 30 to 35 per cent with a decided increase in output and independence of outside sources of fuel. However, the high initial cost of electrification makes it economical only if operations are to extend over several years. There is no doubt that the next few years will witness an era of electrification on those logging operations where favorable conditions obtain, in keeping with the present rate of progress to be noted in main line railroad electrification.

Some Thoughts on Long-Span Bridge Design

Architectural Considerations Controlling—Aesthetics and the East River Bridges—Towers for Delaware River Bridge Too Utilitarian—Wire Cable Problems and Eyebar Chain Possibilities

By Gustav Lindenthal
Consulting Engineer, New York

JUST before the calling of bids on construction of piers for the Delaware River suspension bridge, the Philadelphia section of the American Society of Civil Engineers on Nov. 7 devoted a meeting to that enterprise. At that meeting Gustav Lindenthal, the noted builder of the Hell Gate arch and now chief engineer of the Hudson River bridge project, presented a discussion in which he criticized one or two features of the design as published in "Engineering News-Record" of June 23, 1921, p. 1086, notably the unprecedently large wire cables and the towers. The views he expressed constitute a remarkable outline of fundamentals in the design of long-span bridges, particularly suspension bridges. They are given with slight condensation.—Ed.

EVERY unusually large bridge project offers new problems of construction, and it is a laudable although infrequent practice to offer up the plans for discussion by engineers before they are carried out. In this wise more or less valuable views and experiences on the subject may be exchanged or contributed that may be of benefit to the project and so also to the whole profession.

Architectural Features of Long-Span Bridges

Any large bridge should be designed with a view to fine architectural appearance. That much at least is due to a civilized age and it is particularly important in a city bridge. Every large bridge, even when it is unsightly, has a monumental character from its very hugeness, and causes wonderment. But it should do more than that: it should also give the beholder a feeling of pleasure and enjoyment. That is the essence of architectural art, and the more perfectly it is attained the greater the merit of the work and the greater the regard for the sciences and the arts and for their disciples, who create and leave it to posterity as a proof of culture and progress.

In the case of the proposed Delaware River bridge at Philadelphia the studies seem to have been confined to the cantilever form and the suspension form of bridge.

Cantilever and Arch Bridges—A cantilever bridge is the least adaptable to artistic treatment, but a large span can be given an imposing architectural appearance by the thoughtful engineer, through choosing a pleasing silhouette and through adroit differentiation of the bridge members so that they will express in their form and massiveness the forces they resist. A satisfying aesthetic form for a very long cantilever span as in this case would, however, require the arching of the lower or compression line of the superstructure below the line of roadway, as was done in the two large spans of the Firth of Forth bridge in Scotland, having about the same length as the river span in the Delaware bridge. In the well-known Quebec cantilever bridge, the bottom edge of the structure also descends below the floor line, but unfortunately in straight lines, thus giving the bridge an amateurish appearance and unnecessary ugliness. It is regrettable that the graceful lines of the first Quebec cantilever design were not retained, because it was in its outlines and conception a meritorious design, but collapsed under its own weight; not enough metal had been put into it.

An arch bridge is the next in aesthetic value. From arch designs of nearly 3,000 ft. span (over the Straits of Messina) worked out in considerable detail it is known that arch bridges of very long span offer decided advantages over cantilever bridges, where the shores offer good abutments. But in the case of the Delaware River bridge, for which the government required unobstructed width above the river, it was plain from the first that some type of suspension bridge would best satisfy local conditions. No time should have been wasted on a cantilever design.

It was then a question what kind of suspension bridge. One should think that nearly any kind of suspension bridge would satisfy aesthetic demands, because the graceful curves of suspended cables, nature's beauty line, could not be spoiled by the callousness of man. But that such can be the case, was the experience in the Williamsburgh Bridge, the second bridge built over the East River. No architect was consulted in the shaping of the bandy-legged towers or in the clumsy anchorages, nor were the stiffening trusses made sightly with any thought of forming a harmonious combination with the cables. The result is an unnecessary ugliness which even the untutored mind beholds with surprise. That structure has the distinction of proving how unsightly even a suspension bridge can be made if you try.

Towers—It should be the aim of the bridge architect designing a large suspension bridge, especially in city surroundings, to emphasize its monumental character in its most prominent feature, that is, the towers. They should satisfy the innate desire to give dignity to the structure. It has found expression in all larger suspension bridges, some of them built a century ago. Stone was invariably used for the towers. To this fact all the old suspension bridges owe their reputation for beauty, whether it was of the rugged kind as in the early English and American structures or of the more refined and ornamental kind as in some of the Continental suspension bridges.

The Brooklyn Bridge, completed 38 years ago, was the last suspension bridge with stone towers. The explanation is simple. High stone towers for very long spans are heavy and require big foundations, which are costly when they must be placed under water on deep rock. Metal towers are lighter and cheaper. But up to fifty years ago, cast iron was the only metal that could have been used as a substitute for stone towers and that only for limited heights. Only after the iron rolling mills became capable of producing heavier rolled shapes was it feasible to fabricate large metal towers of rolled iron and steel to take the place of stone towers. The designing of large metal towers as an art is therefore rather young, and only a few good examples of artistic metal bridge towers exist in smaller bridges.

Steel versus Stone—From the aesthetic point of view, metal towers, no matter how finely designed, will never equal stone towers. The finest example of an artistic metal tower is the Eiffel Tower in Paris, which carries no load but its own weight. And yet as an architectural creation it does not impress the beholder with that feeling of dignity and majesty which he experiences at the sight of any of the great spires in famous cathedrals. Although the highest inspiration of the architect as also the cunning skill of the artisan will probably always prefer stone to metal as building material for monumental work, the modern architect is obliged to also use steel and iron. He must create his own precedents in that material, and a large suspension bridge is one of the occasions for it.

The writer held this view when, as Commissioner of Bridges of New York, he took charge of the East River

bridges, nearly 20 years ago. But he found that he could do nothing in that respect during his short term of office. The Williamsburgh Bridge was building, the steel towers and anchorages were completed, the cables and its superstructure were contracted for and in process of erection. For the Manhattan Bridge the narrow tower foundations were already sunk. Such was the case also with the Queensborough Bridge. The revised designs for all these bridges were fitted to conditions that could not be changed. These designs were either mutilated or thrown away by succeeding administrations, involving a loss of many millions of dollars.

Beauty and Utilarianism — Particular effort should be made to dseign the metal towers of a large suspension bridge on artistic lines. The engineer who thinks merely of stresses must combine with the architect, who deals with artistic forms. The thousand-foot Eiffel Tower already mentioned may illustrate the point. When in a discussion with a prominent structural engineer he had pointed out to him the beautiful lines and elegant details of that great metal shaft as a fine example of French artistic skill, it was not a little surprising to hear him denounce that structure as wasteful, exhibiting poor engineering of which no American engineer would be guilty. In fact not long after, an American design, a typical shop-creation, for a very high steel tower was published as an example of what such a structure should look like. Ugliness is rational beauty to minds who see merit only in geometrical figures and in cheap fabrication. It is not unsual for an engineer to be derided by his fellow engineers as wasteful and unscientific if he uses a few extra pounds of metal or a few extra yards of masonry to make his structure more durable or more sightly. If such notions prevail, we may ask ourselves, of what effect are our boasted academies of art and schools of architecture? We have no record of any such institutions existing for the benefit of the architectural geniuses in Greece and Rome, or among the god-inspired medieval cathedral builders of Europe, or among the ancient Babylonian, Indian and Moorish architects, whose wonderful work compels our admiration to this day. We know that they did not get their inspiration from dry mathematical formulas, for they had very little of such knowledge, but they all had in them a spark of that creative supreme force and mind which molds and directs the universe and with it that innate love for the beautiful which like a flame tends always heavenward. The fine arts, which include architecture, will forever remain the true measure and index of human progress and intelligence. Future generations, wiser than ours, will judge our civilization by its achievements in monumental constructions, and for this reason we should feel it as a solemn duty and an obligation to the community to do our best in that field.

Viewed from that point, the towers of the proposed Delaware River bridge do not present a good design. They are too much on the utilitarian principle of braced telegraph poles or derricks, holding up ropes. The few architectural touches and articulations in the surface of the columns and caps are not visible from a distance and do not relieve the unpleasant impression of naked utilitarianism. The steel towers should have at least four columns to express stability and power and should have a form and bracing for which the French school of architecture, for instance, furnished fine examples of artistic treatment in the buildings of the Paris International Exhibition in 1900. From designs studied in that manner a choice could be made that would testify to the pride and good taste of opulent cities like Philadelphia and Camden, just as some of the beautiful bridges in Paris and London do for those cities.

Such towers, provided with stairways or elevators to make the top readily accessible to visitors, would require a wider base, but not necessarily a more expensive foundation, nor would they on the whole cost much more than the proposed towers. They would give the bridge its true monumental character and take it out of the commonplace. The towers should be fully designed and considered before the foundations for them are commenced. Because if the proposed narrow foundations were commenced, it would make the designing of more beautiful towers impossible. This happened in the case of the Manhattan Bridge (of which the proposed structure is an imitation), where the narrow foundations prevented a design for monumental towers and a wider bridge. This bridge, only a few years old, is already too small, so that it is used only as a one-way bridge in rush hours mornings and evenings. So is also the old Brooklyn Bridge.

As the high anchorages for the Delaware Bridge will be visible from a long distance on the river and from the shores, their silhouette and architecture should be fitted to that of the towers. That applies of course also to the suspended structure. Each has its proper share in the harmonious whole of a monumental bridge. The dominating feature however, will always be the towers.

Some Construction Details of Suspension Bridges

Wire, because of its greater tensile strength than bars or rods, found early use in suspension bridges. French engineers (Dufour in 1823 at Geneva) were the first ones to use it, while English engineers (Telford 1820) had a preference for chains of iron, in the form of forged eyebars. The difficulty found in straining the wires to uniform tension made the French engineers cautious, and so they preferred the method of construction which consisted in composing the wires into strands of parallel wires (occasionally also in the form of wire ropes). They were made on land. The strands hung side by side in vertical planes. The suspenders hung from crossbars on top of the strands and were lashed to them. This was also the construction of the first wire suspension bridge (1,100 ft. span) built over the Ohio River (1846) at Wheeling by the French engineer Ellett. The twelve strands for it were completed on land and hung on the towers. Shortly after its completion, a tornado turned the bridge upside down. John A. Roebling, who had already built a few smaller wire bridges, repaired the Wheeling Bridge. He disentangled the strands, and compacted them into two cables. Corroded wires in the anchorage were cut out and replaced. The bridge is kept in good repair and still in use, while most of the early wire bridges in France broke down from neglect and corrosion.

Roebling subsequently introduced the method of spinning the cables in the air and compacting the wires into cylindrical form by wrapping them with a continuous softer wire. This was the method followed in most American wire cable bridges. Only for two wire cable bridges over the Ohio River (at East Liverpool and Portsmouth) were the strands for the wire cables made on land.

All the early suspension bridges everywhere were built with flat catenaries, to which they owed their comparative rigidity in the absence of adequate stiffening frames to prevent undulation in the cables and chains from loads and wind. To the flat catenary (with a deflection $\frac{1}{10}$ to $\frac{1}{15}$ of the span) must also be ascribed the success of air spinning and compacting the wires under nearly uniform tension into solid cables, so that loose wires in them were rare and, in small cables, easily discovered and rectified. The last cables with flat catenaries, $\frac{1}{11}$ of the span, were those of the Brooklyn Bridge. The wires were laid up on a still flatter catenary than that of the finished cables, by moving the saddles on the stone towers toward the anchorages and thus increasing the tension in the wires during erection of the cables; this method was a great help to the better adjustment of tension in the wires before they were compacted.

The four Brooklyn Bridge cables, each 15¾ in. in diameter, were completed in 21 months. The next large cables, in the Williamsburgh Bridge, with about $\frac{1}{9}$ deflection, were finished in 7 months, and the wire cables in the Manhattan Bridge, with $\frac{1}{8}$ deflection, were finished in 4 months. The successive shorter finishing times indicate the progress made in rapidity of cable construction, but it is a moot question whether the quality of the cables, as regards evenness in tension of wires, is as good in the latter as in the Brooklyn and earlier bridges.

Many loose wires near the towers were observed during the compacting of the cables in the Williamsburgh Bridge.

and they occurred also in the Manhattan Bridge. The compacting and wrapping machines, starting from the middle and working towards the towers, compact the carefully laid wires so tightly that it would be impossible to pull out a single wire from the compacted portion only a few feet long. Loose wires can be adjusted in length only by cutting them and inserting a little turnbuckle splice, with which to tighten the spliced wires if possible to the same tension as the other wires. The trouble is, however, that with all possible care in laying the wires, each adjusted in length with the guide wire, their length is constantly changing from changing temperature conditions in open-air work, exposed to sun and winds. There always occur wires a few degrees warmer than others, producing local differences in tension and position in the same wire when in part already gripped in the compacted part of the cable. The compacted wires cannot slide on each other between the bearings on the towers, where they are held fast by their pressure. So the wires with less tension are forced together and compacted with those of higher tension. But where the wires are not yet confined and compacted, they will bulge out, particularly as the compacting machines are nearing the towers. If the tension in the parallel wires at any one section of the cable differed even as much as 25 per cent, it would mean no more than that some wires are stressed more than others, but that on the whole they are pulling together. The modulus of elasticity for the cables would of course be much lower than for the simple wires, but in the aggregate the entire cable section may have a sufficient margin of strength and safety. If the unequal tension in the wires can be controlled and kept between certain limits by careful work in the compacting of the cables, the total effective elastic strength of the cable, the only thing that counts, will be lowered, but still will be high enough to include maximum stresses from loads and temperature. But this condition can be attained by simple methods only in smaller cables, in which the loose wires can be discovered and adjusted. As the diameter of the cable and the number of wires increase, such adjustment becomes increasingly difficult if not impossible.

Manhattan Cables Near Limit

The cables in the Manhattan Bridge, 21 in. in diameter, may be considered as the limit of size for such work, and it is not at all certain that the limit for safe air work was not already then exceeded. There exist no reports on the condition of the cables, during erection, except the observation of many loose wires forced into position by the compacting machines. If large cables, before being compacted, could be uniformly loaded with a large part of the suspended load, which would produce in the wires between bearings greater tension and stretch than that due to their own weight plus the elongation from the highest summer temperature, and allowed to slide freely upon each other during their elongation, and then compacted in that condition, each wire in the cable between bearings would be under uniform tension although the many wires may differ slightly in tension one with the other. The aggregate strength of the cable would be brought nearer to the theoretical strength, which is equal to the sum of the wires. This method would require special preparation and would obviously be costly, and slow. A less effective alternative method would consist in starting the compacting machines on the empty cables from each tower down towards the center and ends, instead of the reverse, which latter is the accepted practice. The bulging of loose wires would then occur in the middle of the river span and near the anchorages instead of near the towers. Their adjustment and resplicing would occur at those parts of the cable where they have a surplus of strength and so would be less harmful. But the difficulty, if not impossibility, of reaching loose wires in the interior of a large cable would remain.

Thus, we do not lack methods and means for making large wire cables of reliable strength, if they have to be made irrespective of cost, and if we have enough faith in their durability, which is not however justified to the extent of believing them as durable as eyebar chains. The engineer should prefer that construction which for the same money is the best and affords the greatest permanence.

This leads to the subject of *maintenance of cables*. The best practice to preserve the wires against corrosion is undoubtedly galvanizing, i.e., covering them with a zinc coating. That practice was followed in the Brooklyn and Manhattan Bridges, but not in the cables for the Williamsburgh Bridge. The wires here were covered by a thick mineral oil paste expected to fill the interstices between the wires to make them water- and air-tight. That expectation was not fulfilled. Moisture condensed from the air penetrated the interior of the cables, which are enclosed in thin steel mantles. Corrosion started and repairs became necessary within a few years. Thick white lead paint filling up all hollow spaces is the best protection for that purpose.

Dangers Which May Develop

But there is nothing permanently perfect in this world. As the zinc covering of wires may in the handling of them become abraded in spots and leave bare spaces, protection cannot be absolute. Some accidental stray electrical current may find the weak spots and by electrolysis start corrosion where it cannot be known or got at. In this connection we must keep in mind that the great strength of the wire is in the outer layers of metal near the surface, which is the reason why small wires are proportionately much stronger than large wires. If the surface corrodes away, the wire breaks easily. Several French suspension wire bridges hardly twenty years old fell down, some 60 to 70 years ago, one after another, rather suddenly, because there had been neglect in painting. The outside painting of cables can of course not stop corrosion inside and hold up a bridge. We see plain fence wire after a few years literally disappear like dust, particularly in smoke-laden air. Galvanized wire will last longer, but when corrosion does get a start, the wire seems to vanish even faster than plain wire. It is so with tin roofs and tin cans.

The writer had been a strong advocate of wire cables for large suspension bridges for many years. They appeared to be an ideal method of construction for very long spans at lower cost than other bridge types. But when on closer study and observation he discovered the practical difficulties arising from greater span and larger size of parallel wire cables, he came to the same conclusion as other observing engineers, among them the late Geo. S. Morison, certainly a high authority. In his paper, (A. S. C. E., Vol. XXXVI, 1896) on a study for a large suspension bridge, Mr. Morison had chosen for his 30-in. cables coiled wire strands, finished in the shops to accurate length and submitted to a proof-stress before erection, as preferable to cables with parallel wires.

The writer had about the same time examined into the practicability of fabricating wire links, (to be enclosed in a roomy shell of noncorrodible metal), with which to compose chains for suspension bridges. His first design for a suspension bridge at Quebec (1899) included that construction. The links were to be made of rectangular wire with corners rounded off, each link submitted to a proof stress. They were guaranteed as to strength and quality under rigid specifications by the large wire firm of Felten & Guilleaume of Cologne. There would have been absolute certainty as to the strength of chains of this construction. This same firm as well as other firms manufacture several forms of patented coiled wire cables, which have been used in suspension bridges of moderate spans with great success. These were at first proposed also for the new Budapest suspension bridge in 1894. But the engineers for that bridge decided finally, after long deliberation, in favor of chains of eyebars cut out of wide plates. There are no plants in Europe for making forged eyebars. The finer architectural appearance of huge eyebar chains and their greater durability were the final deciding factors.

The questionable condition and apparent uncertainty of strength of the large wire cables in the Williamsburgh Bridge induced the writer, as Commissioner of Bridges for the city of New York, to avoid large wire cables in the plans for the Manhattan Bridge. The design provided. therefore, for chains of forged eyebars of nickel steel,

which appeared to have many advantages over chains of wire links. That design was submitted to a board of five eminent bridge engineers and approved by them. Their report has been published (Trans. A. S. C. E., Vol. LV, 1905, pp. 89-93, Report by Geo. S. Morison, C. C. Schneider, Mansfield Merriman, Henry W. Hodge, Theodore Cooper). In comparing chains and wire cables their first report to Mayor Seth Low set forth:

The chains have decided advantages in the accessibility of all parts for inspection and protection as well as in economy and rapidity of erection. They are to be preferred to wire cables whenever the cost of chains is not materially greater. The cost of eyebar chains and wire cables in this bridge would be about the same.

In their final report they said,

We deferred our final report, relating to the quality of the material to be used for the eyebar cables, until additional tests could be had and we should be satisfied, by correspondence with the leading manufacturers of structural steel, that the desired material could be obtained at reasonable price and in open competition. In our preliminary report, March 9, (1903), we reported favorably on all features relating to the design of this bridge, subject only to the uncertainty of obtaining this quality of material. This uncertainty is now removed. In this final report, we unanimously recommend the adoption and execution of the proposed design of the Manhattan Bridge, as submitted to us by the Commissioner of Bridges.

The reason why the Manhattan Bridge was not built on the approved plans is well known. Before the contracts could be let, another city administration was elected, which also changed the management of the Bridge Department. The approved plans were thrown away, and new plans were made for a wire cable bridge, costing several million dollars more than the chain bridge. No board of engineers was called into report on these new plans, or compare them with those already approved. The character of bridge management can be judged from the fact that the courts were appealed to by outwitted bidders to stop fraud in awarding contracts on manipulated bridge specifications. That a management of this kind would be very much concerned about the quality of the work or about progress in the art of bridge building was not to be expected and it is for this reason that we are without reliable scientific information or records on many details of erection and maintenance of the East River Bridges of that period. Among these are the actual condition of the big wire cables, erected in the unprecedented short time of 4 months, a very creditable performance, provided it was not at the cost of quality.

30-In. Wire Cables Big Advance

In any event, there is no reliable basis or safe precedent for a leap from 20-in. cables to 30-in. cables with parallel wires, as now proposed for the Delaware River bridge. It would be a great achievement, most desirable also from the architectural point of view, to have big wire cables. In the writer's studies for the North River bridge they would have been 60 in. in diameter. But it is one thing to design them and another thing to be assured of their safe obtainment.

That there are large secondary stresses in large stiff wire cables is now better understood than when the East River bridges were built, where they were not considered. The largest stresses from tension and bending occur at the towers, just in that part of the cable liable to have the most wire splices from adjustment of wires. Safe provision can of course be made for secondary stresses by increasing the cable section and leaving 150 to 200 ft. of cable at the towers uncompacted, so that the wires can slide on each other for that length to prevent excessive stresses from the bending of the cables. All this can be done, but it adds to weight and cost of cables and is poor construction.

In chains of eyebars no uncertainties of stresses can occur, as all determination of length and all fitting are done in the shops with great accuracy, which must be one of the determining elements in any great metal bridge. This feature was well considered in the design made for the Pennsylvania Steel Co. for an eyebar suspension railroad structure at Quebec in 1910. In *Engineering News* of Nov. 23, 1911, the comparison of weight is given with the official equivalent cantilever design. The competition in this case did not decide the merit of any competing designs, as the contract was awarded to a cantilever structure not complying with specifications and therefore 30 per cent lighter than any other design, including the so-called official design. The length of the river span (1,756 ft.) in this design was practically the same as in the proposed Delware Bridge (1,750 ft.), so that the two are readily comparable when transposed to the different load conditions and the higher unit stresses would would be justified with the present higher steels.

In this connection the report above mentioned on the chain design for the Manhattan Bridge, a carefully considered judgment from engineers of great experience and high attainments, is worth thoughtful consideration. The cost of eyebar chains and wire cables is mentioned as being about the same (in 1903). The comparison was based on nickel-steel eyebars with 48,000 lb. elastic limit and 85,000 lb. ultimate strength. That was also the basis for the chain design for the Quebec Bridge, 12 years ago. But since then progress has been made in the metallurgy of steel, and large eyebars can be obtained of high steel with elastic limit and ultimate exceeding 80,000 and 110,000 lb. respectively. With such material an eyebar suspension bridge cannot help but be superior in quality to a wire cable design, and also cheaper in total cost, when properly designed. It is surprising that improvements in the art are ignored and that no studies for chain designs have been made by which the merit and economy of the proposed wire cable bridge could be tested. That could probably be best done by a competition of designs, but not of the kind had on the Quebec Bridge.

Studies for a large bridge cannot be considered complete until every phase of it has been examined in the light of progressive scientific knowledge. But in all or any designs for a large city bridge, architectural considerations should prevail, for the reasons already stated. That much its builders owe to the public and our age.

Railway Electrification in England

REGULATIONS recommended to the British ministry of transport in the final report of the technical committee on electrification of railways, in order to promote standard practice, provide for a direct-current system of 1,500 volts, but permit higher voltage in multiples of the standard pressure and also 750 volts where sufficient advantage can be shown. Continuance of existing 600-and 1,200-volt systems is approved, however, mainly for the reason that the London, Brighton & South Coast Ry. long ago adopted a single-phase alternating-current system for its suburban lines and is intending to extend this system on its 50-mile main line to Brighton.

Both overhead and third-rail collecting systems are permitted. For third-rail conductors either the top or bottom contact system may be used, but the latter is considered to have advantages in regard to snow and ice accumulation and to protection of men working on the track. In either case, the contact rail is to have its center line 16 in. from the gage side of the track rail, the contact surface being 3 in. or 1½ in. above the track rail for top and bottom contact rails respectively. Where overhead conductors are used, the distance between the conductor and the clearance line of equipment is to be 36 in. on the open line and 10 in. in tunnels; at grade crossings the conductor must be 18 ft. above the rails, and at points where men may have to work on top of the cars the height must be 20 ft. Overhead conductors must be 21 in. from the center line of track at 4 in. above the equipment clearance line, and 15 in. at a height of 18 ft. above rail level.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Improving the Terminology of Mechanics

Sir—I offer a few suggestions respecting the nomenclature and notation of mechanics, or dynamics, as it has been designated in recent years.

It is quite generally known that *dynamics* is the science which treats of the action of forces upon bodies and that it is subdivided into statics and kinetics, *statics* applying to bodies in equilibrium and *kinetics* to those in motion. The older term *mechanics*, according to modern usage, should apply exclusively to the structures of transmission of force, whether these be machines and other mechanisms, trusses, or matter structures. The expression *dynamic loading* should be superseded by *kinetic loading*, since the Greek root for kinetic signifies to move, whereas dynamic applies equally well to conditions of rest or motion.

The best definition for stress was once given by Professor I. P. Church—distributed force. It is force per unit of area. The expressions *unit stress* and *total stress*, literally signifying unit-unit and total-unit, should be superseded by the terms *stress* and *force* or *traction* respectively, or their equivalents, the term traction being already used in dynamics for the latter purpose. A pressure is a negative traction.

The term *strain* is a unit and had best replace such redundant expressions as unit deformation, deformation in inches per inch, unit elongation, unit shearing distortion and the like.

Ultimate stress should be understood to mean the last recorded stress applied during a test. It should not be confounded with the expression *maximum stress*, which should be used in its strict mathematical sense as "peak of the load" or greatest.

The expressions *bending stress* and *torsion stress* should be replaced by *bending couple* and *twisting couple* or *torque*, as, strictly, there are no such stresses. Works, torques and bending moments should be stated as pounds-inches, etc., instead of the reverse, as the idea of force by distance is fundamental.

There is no scientific basis for the use of such terms as *true* and *apparent stresses*. A lateral stress is not induced when a bar is stretched in the direction of its axis and this cannot be shown analytically or by tests. It would therefore seem advisable to omit a consideration of these "stresses" in texts and engineering pocket books, as they are not recognized in the standard dynamical treatises and are generally misleading to young engineers and students.

It would seem advisable to introduce into engineering texts the modern notations and methods of combining stresses and strains as given in dynamics, abandoning the notations and methods based on the older authorities, Rankine, Lamé, and Townsend, which have outlived their usefulness. An engineer using the strict dynamical methods of obtaining principal stresses, combined stresses and resultants can solve his problems more effectively than by the older methods, which are cumbersome. Again, where the particular ellipse-of-stress method of Rankine is used considerable time is required in reducing the problem and its conceptions to paper. The standard dynamical method is easier and more expeditious, in that it can be worked out quickly by slide rule.

As regards notations for stress and strain, Kirchhoff's is to be preferred. It conveys at a glance the meaning of each symbol, one may say automatically, in a somewhat analogous way as is done by the well-known notation of Bow in graphical analysis of structures. Capital letters corresponding to the co-ordinate directions suffice for the stresses, while subscripts to these letters indicate the planes on which the stresses act. The terms X_x, Y_y, and Z_z, for example, indicate stresses pointing in the respective co-ordinate directions on planes perpendicular to these directions. The term Y_z is the stress acting in the direction of y on a plane whose normal points in the z direction, and so on. The corresponding strains are indicated similarly, but with a lower-case letter and subscript. A further desideratum exists in the fact that cyclic symmetry prevails throughout in equations for stress, this symmetry being absent in the engineering notations. It renders formulas of more general utility and easier to memorize.

J. H. GRIFFITH,
Professor of Experimental Engineering, Iowa State College.

Ames, Iowa,
Oct. 29.

Detecting Flash Setting Cements

Sir—We have read the article in your Oct. 27 issue by C. L. Jenkin on the setting time of cement with appreciative interest as it touches on a feature of the testing and use of cement which we think deserves far more serious attention than it usually receives.

In our cement testing department we have frequently noted the conditions described by Mr. Jenkin and have come to the conclusion that some cements have a latent tendency to flash setting which is difficult to detect by the conventional test for setting time. We tried various means of revealing a tendency to flash setting which the cement test did not disclose and found three methods which apparently were of equal effectiveness. We sometimes heated the cement and water to 100 deg. F. while on other occasions a cement that was under suspicion would be exposed to the air in a thin layer for 24 hours. The third expedient consisted in allowing the cement, after adding the water for the setting time determination, to remain undisturbed for five minutes before mixing into a paste. If a tendency to flash setting exists in cement it is usually impossible to mix it to a paste if allowed to stand for five minutes after adding the water. The two methods first mentioned are frequently effective in so exaggerating the tendency to flash setting as to make it clearly apparent by the cement test.

Curious beliefs spring up in the trade concerning cements. On a recent day we heard a certain brand of cement bitterly criticised by one contractor for slowness in hardening and by another contractor for setting so quickly as to present difficulty in getting the concrete into the forms before setting occurred. This apparent inconsistency is probably due to the fact that the cement in question almost always tends to become flash setting or else has the ability to develop what might be termed a false initial set. The slow hardening complaint was probably due to the fact that the set was broken during the mixing with resultant slow hardening while the party who found that it hardened too quickly was probably mixing too short a time to break the set so that setting commenced in the buggies and chutes.

While for many purposes the presence of a flash setting tendency in cement may be ignored, it is of vital importance that cement for concrete floors, sidewalks, roads and many other uses be normal as to setting time.

E. L. CONWELL,
President, E. L. Conwell & Co., Inc.

Philadelphia, Pa.
November 1.

Stresses in Eyebar Heads

Sir—I have read with interest Josef Beke's article "A Study of Stresses in Eyebar Heads" in your issue of Aug. 11, p. 234. However, the formulas for X_o and M_o, which I have checked by an independent derivation, impress me as too theoretical, by which I mean that the assumptions on which they are based do not cover important points of the existing conditions with sufficient approximation, so that the finely worked-out formula after all gives only a rough approximation.

The eyebar head is not a ring, as the body of the bar is continuous with the head and restrains the deflections and angular deviations of the head. The actual stress in the head must lie somewhere between the stress in a ring as computed by Mr. Beke and the stress in a bar with the body as wide as the head. By taking 50 per cent of each stress and adding them together the result must be nearer the correct value. It is questionable, also,

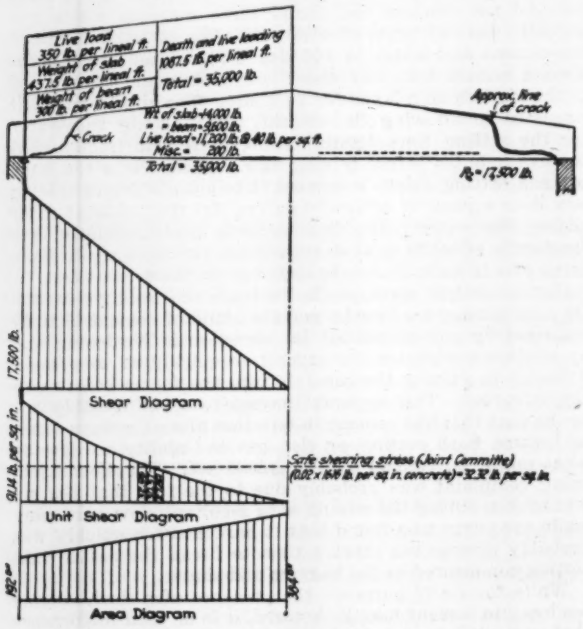
whether radial plane sections will remain plane; I believe that the transfer of the direct stress from the bar to the head does not take place on the middle line of the head but is crowded nearer to the pin hole.

However, I believe that a value for the tension at the inner edge on a transverse diameter, $S_x = 2.5T$, where T is the unit stress in the body of the bar, is approximately correct. By a much simpler method I have arrived at a value for S_x equal to 2.4T. I do not give this method as it is nothing but an application of the moment area method to a fixed beam. It is with this as with Euler's formula where the assumption of an ideal column (a thing never found) necessitates the use of higher mathematics, while an approximate method gives the same result with a difference of a few per cent. C. L. CHRISTENSEN.

Detroit, Oct. 25.

Another Concrete Failure Due to Poor Design

Sir—We are continually hearing of failures in concrete structures due to what "after the accident investigators" call "poor design," or a design fundamentally inadequate in strength, but the real reason may be more truly stated to be either ignorance or gross negligence on the part of the designer.


Live load 350 lb. per lineal ft.
Weight of slab 437.5 lb. per lineal ft.
Weight of beam 300 lb. per lineal ft.
Dearth and live loading 1087.5 lb. per lineal ft.
Total = 35,000 lb.
Approx. line of crack
Wt. of slab = 4,000 lb.
" " beam = 9,600 lb.
Live load = 11,200 lb. @ 40 lb. per sq. ft.
Misc. = 200 lb.
Total = 35,000 lb.
Crack
R = 17,500 lb.
17,500 lb.
Shear Diagram
91.4 lb. per sq. in.
Safe shearing stress (Joint Committee) (0.02 x 1/8 lb. per sq. in. concrete) = 2.5 lb. per sq. in.
Unit Shear Diagram
Area Diagram

REINFORCED-CONCRETE ROOF GIRDER WITH NO SHEAR REINFORCEMENT—IT FAILED

I am showing herewith another glaring example of what we may call, for politeness sake, "poor design" made by a firm of industrial engineers in New York City. On the drawing is shown one of the typical roof beams which failed. This beam was built to support the roof of a pump house and the lines of failure are as shown on each side of the beam. These beams were spaced 8 ft. 9 in. c. to c. The length of beam was 32 ft. The height of beam varies from 2 ft. to 4 ft. high by 8 in. wide. The steel allowed was two 1¼-in. longitudinal straight bars, placed at a distance of 5 in. up from the bottom of beam. This was to carry a total loading of 35,000 lb. Under the sketch is shown a table, a shear diagram, an area diagram, and also a unit-shear diagram. And it will be noted that from stresses due to moment the steel is being asked to take 21,400 lb. per square inch with the concrete at 975 lb. per square inch. This is excessive, and good engineering practice would have called for stirrups or other web reinforcing where the shear exceeds 32 lb. as shown in the sketch.

Is it not therefore to be wondered, in viewing the above from the designer's point of view, why these beams did not fail long ago? The beam was poured monolithically with the concrete side walls, and there was therefore a tendency for cantilever action, and further, the tops of the beams at the ends were in tension with a negative bending moment, as is the case in continuous beams. The steel was placed at a distance of 5 in. above the bottom of the beam, which is too great for good engineering practice. Only enough covering is required to ensure bond and fire protection, which is surely not as much as 5 in.

The high shear and diagonal tension stresses which set up in this beam near the ends were not properly taken care of by shear reinforcement and we have therefore failure in the beams along lines of structural weakness as the natural and logical result. HERBERT CANTWELL.

Espanola, Ont., Oct. 26.

Locomotives and Railway Bridge Strength In China

Sir—P. H. Chen's article on the relative impact from American versus European locomotives, in *Engineering News-Record* of July 14, p. 58, has caused much comment both here in China and in America; over here offering an opportunity to deliver encomiums on American locomotives and hurl abuse at European bridges, without much endeavor to analyze the matter.

Certain observations simplify the matter somewhat. Since the impact from American locomotives was brought under suspicion, many have insisted on imputing the rather large difference in weight between American and European bridges to provision for such impact. As a matter of fact the difference is largely accounted for on other grounds, the American designs providing for greater permissible overloading, and for less rapid wearing out of the structures. The American bridges could undoubtedly be made lighter and hold up their loads, but usually the regret is that they were not made even heavier on account of unexpected load increases.

The problem has been discussed from the too narrow viewpoint of the bridge engineer over here. Of course the question of locomotive design was bound to be injected into the discussion, but the effect of locomotives on bridges (all-important in bridge design) counts for but little in the broad considerations involved in selecting locomotive types. By exaggerating the place of bridges in a railway system we have attempted to rate the excellence of locomotive according to their effect on bridges. Now, locomotives are not designed simply to provide loads for bridges, but bridges are designed to carry locomotives, and to carry such locomotives as are necessary to handle the traffic economically. If the American locomotive types are the best to carry the traffic, then the bridges must be designed to carry them, and if China's traffic conditions are coming to resemble America's, and if China wants American motive-power efficiency (the few American locomotives in use here are more than proving their work), then China should adopt American locomotives with the bridges they entail, and not complain of a few extra pounds of steel, if necessary, especially since they provide for a reasonable overloading, which may prove of great value under unexpected increases in traffic.

The tests made, aside from their insufficient number to draw any conclusions from, may be questioned as to their validity, as other factors besides locomotive weight must be considered before we can make any general statements about excessive impact; for example, the operating speed designed for, extra strength in reciprocating parts to permit of being operated at maximum capacity all the time and minimize repairs (requiring different counterbalancing), requirements that necessarily and justifiably give one locomotive greater impact than another of about equal weight.

One fact probably may be revealed, namely, that American locomotive builders are looking into Chinese operating requirements less carefully than the Eureopean firms, for example, in regard to providing extra strength so that it will be permissible to shift crews on the locomotive as necessary in America, while in China one crew stays with a locomotive and takes pride in its upkeep.

On account of the great effect of the period of vibration

of the structure and of different kinds of piers on impact, valid comparisons cannot be made between experiments made in Europe and those made in America. The same bridges ought to be used for all the kinds of locomotives tested, and here in China there is abundant opportunity for looking into the matter. The tests should be continued not so much to see whether American or European locomotives produce the greater impact, which is after all a less important matter (as locomotives are selected on broader economic considerations) but to decide whether the European type of bridges now used on many lines can longer be tolerated on the Chinese railroads.

Tientsin, China, Oct. 12. JOSEPH H. EHLERS,
Professor of Structural Engineering,
Pei Yang University.

Figuring Stresses in Concrete Chimneys

Sir—In the article in your issue of Sept. 29, p. 512, entitled "Short Cut Design of Concrete Chimneys," the method of determining the vertical steel required in a concrete chimney by designing a steel chimney is in error. The vertical tension in any chimney is due to the wind pressure less the weight of the chimney. It is quite apparent that the weight of a concrete chimney is much greater than that of a steel chimney, and the net tension is therefore much less.

In regard to the foundation, the center of gravity of the pressure diagram is of course at the point of application of the resultant. The pressure diagram extends from the edge of the base nearer to the resultant to some point determined by the shape of the base. In a square base with the wind pressure parallel to two sides, this point is three times the distances of the resultant from the nearer edge, provided of course, the diagram does not extend past the further edge of the base. There cannot be any tension on the soil whether the diagram extends entirely over the base or not. In the case of small steel stacks, the pressure diagram very rarely extends entirely over the base.

The problem of finding the pressure diagram is very simple in the case of a square base with two sides parallel to the wind pressure. It is much more complicated with an octagonal base. It may be found, however, by the prismoidal formula, and a formula derived which makes calculations simple. The object of finding the pressure diagram is of course to determine the maximum soil pressure on the leeward side, which is the critical point of the design. J. T. N. HOYT.

Roof-Shield Work and the East Boston Tunnel

Sir—The article of W. C. Briggs, "Timbered and Roof-Shield Tunneling in Deep Loose-Ground Subway Section," published in *Engineering News-Record*, Oct. 27, p. 676, describes the construction of a section of Brooklyn subway by means of a roof-shield. It is claimed the roof-shield was unique because of the fact that the shield was shoved directly after placing of a ring of concrete, the shield jacks depending for their reaction upon push-rods embedded in continuous lines in the concrete of the tunnel shell. Mr. Briggs adds that so far as the author is aware the combination of a shield, concrete forms and wet concrete immediately behind the shield had never before been used.

It seems to me that the same method has been used in the construction of some sections of the Boston subway, described in the reports of the Boston Transit Commission, Howard A. Carson, chief engineer, and also in *Engineering Record*, Feb. 26, 1898. The same method was exclusively employed in the construction of the East Boston tunnel, the description of which is found in the reports of Boston Transit Commission for the years 1901 and 1902, in *Engineering Record*, March 23, 1901, in *Engineering News*, Jan. 23, 1902, and illustrated by myself in *Traction and Transmission* (London), in March, 1902.

New York, Oct. 28. CHARLES PRELINI.

(Mr. Briggs' reply to the above comment follows.—EDITOR.)

Sir—In reply to Mr. Prelini I have to say that apparently he is in error in his reference to the Boston Tunnel described in *Engineering Record*, Feb. 26, 1898. which has a brick arch lining instead of concrete. His other reference, however, is correct, so much so, in fact, that as soon as I examined it, I was convinced that the Brooklyn construction was copied from it. In following the matter up, I learned (as I had already guessed) that Robert A. Shailer, consulting engineer, Boston, Mass., who has always been thoroughly conversant with Boston tunnel construction and has been identified with some of it, recommended the shield plan, about as adopted, to the Degnon Contracting Co.

Except for making up an independent proposal in 1916 for the Brooklyn work described, I had no connection with it whatever until after my predecessor had left it; consequently, I knew one of the details relative to the adoption of the shield method. In connection with the proposal referred to, I had a library search made covering certain types of tunnel construction; it just happens that the particular Boston tunnel section referred to by Mr. Prelini was not mentioned in the search, although other sections of the Boston tunnel were.

It pleases me to have the error corrected and I am thankful to Mr. Prelini for his interest in the matter.

Brooklyn, Nov. 14. WALDO C. BRIGGS.

In Defense of the Engineer

Sir—The extract of Mr. Cabot's speech headed "The Engineer a Failure as a Manager," in *Engineering News-Record*, Oct. 27, p. 692, certainly requires rebuttal. Not that Mr. Cabot's opinion (which he states as an accepted fact) is generally held either in or out of the profession so far as I can determine, but merely on the ground that a statement, no matter how erroneous, will gain credence from unchallenged repetition.

At the outset we must admit that if to have one's feet on the solid ground, to know and weigh the obstacles to be overcome, to not fail in the critical hour, be faults, then the engineer is damned. But with Mr. Cabot's major premise that the engineer is born without imagination and has his idealism throttled in infancy we do take issue. No aesthete can be crassly material nor devoid of imagination.

True it is that the engineer of fifty finds his enthusiasm of the twenties somewhat damped, his idealism somewhat dazed by the glare of a commercialized world, and his imagination perhaps dulled by the necessity of keeping his nose to the grindstone. So also does the lawyer, the manufacturer, the statesman and the hod-carrier. I have never heard a banker accused of having either enthusiasm or imagination, so cannot say if this applies to them. In citing instances to justify his conclusions Mr. Cabot begs the question by admitting that the banker "yearning for a sure thing," picked the engineer. The inference that in such selection the qualities under discussion would be a bar is inescapable. Though the profession lays no claim to a monopoly of imagination and idealism it would probably be rank heresy to suggest that the banker was in any wise to blame for a poor selection from a good field.

For the rest Mr. Cabot's argument appears to be a disjointed attempt to saddle the blame for the failure of sundry trusts onto the profession though no engineers were connected with them; and to hold the railways up as a horrible example when, by his own admission, the politicians and bankers are responsible for their condition insofar as it is not attributable to economic conditions brought on in part by these same trusts.

The statement that the engineer's "natural position is that of the hand which executes rather than the mind that conceives. Leadership is not native to him," is a bald slur which is probably father to the wish and needs only to be stated alone to fall of it's own weight.

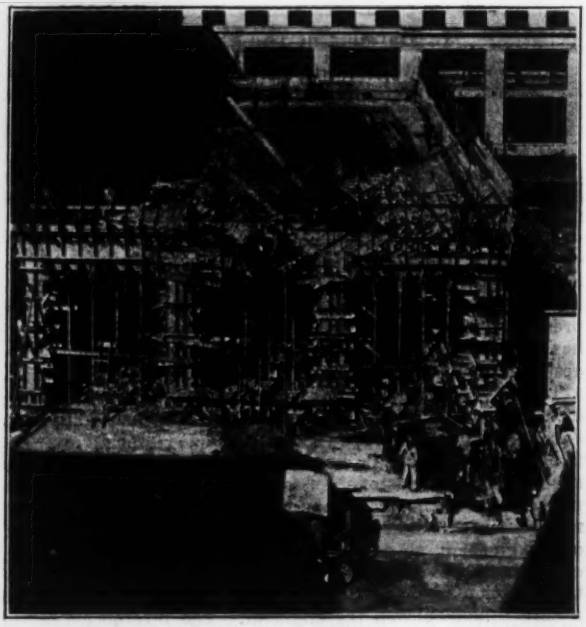
In short, Mr. Cabot's complaint in so far as it can be analyzed boils down to this: The banker entrusted his enterprises to engineers carefully selected for lack of imagination and their readiness to "take orders," and now, dissatisfied with the result, tries to indict the profession for his own fault. C. E. MUHS.

Chicago, Ill., Nov. 5.

HINTS FOR THE CONTRACTOR

Motor Truck Supplants Concrete Buggy Hoist on Small Job

ON JOBS in which a comparatively small amount of concrete has to be elevated, particularly in the construction of one-story buildings, Barrett & Hilp, contractors of San Francisco, Cal., have several times found it economical to use a light motor truck instead of bringing a motor driven hoist to the job. The truck is usually operated up and down on the street in front of the work. By means of a single line running from the truck through snatch blocks on the ground and over a sheave above the landing platform, as the truck moves backward and forward it raises batches of concrete or lowers empty containers.



MOTOR TRUCK REPLACING HOIST ON SMALL JOB

In the accompanying picture this plan is shown in operation on a building where concrete was raised in hand buggies about 18 ft. above street level. On this job it was possible to locate the truck runway so that the driver would at all times face his work. The support for the hoisting sheave here consisted of two uprights (each made of two 2 x 6-in. timbers spiked together) placed vertically 8 ft. apart, and set so the cross tie between them overhung the face of the building by about 30 in. The cross tie was placed high enough so it would handle concrete to be delivered by gravity into the top of the parapet wall. These uprights require guy wires to insure stability.

With this arrangement 90 cu.yd. of concrete was hoisted per 8-hour day, using the regulation 6-cu.ft. concrete hand buggies and a mixer whose charge would provide the proper load for two buggies. The buggies had ½-in. iron bars welded diagonally across their tops for convenience in attaching the hook by which they were hoisted. On this job the buggies were handled at the rate of 36 seconds per round trip, i.e., one full buggy hoisted and one empty buggy lowered. This rate of delivering material was maintained with a crew of six or seven men and the truck driver, distributed as follows: two men landing buckets on the upper level, two buggy men on the ground between mixer and hoist and two buggy men on the upper level delivering to forms. Three buggy men were required on the upper level when the forms to be filled were well away from the hoist.

With the arrangement as shown in the picture, if the attendant on the ground is careless or lazy the descending empty buggy is likely to strike a full buggy which is standing in position ready for hoisting. Danger of breakage due to this cause would be lessened, it has been pointed out, by the use of a runway hung alongside the hoist frame on a horizontal axle and set so the top of the runway could be tilted out under the descending buggy, deflecting it to one side, preferably toward the mixer. By attaching a counterweight on the bottom of such a runway, it would automatically return to vertical position when released, thus leaving no obstruction in the way of the ascending buggy.

Rockskip Made From Boiler

A UNIQUE piece of equipment for handling rock is being used by the Hugh Nawn Contracting Company on the Gilboa dam, New York. It is a rock skip, illustrated in the accompanying photograph, and made of a vertical tubular boiler. The boiler shell was cut in half, a new iron strip was bolted to the inside of the tube head at the top, and another strip with a hook, at each end. The whole formed a skip for handling rock hoisted either by derricks or by cableways.

IMPROVISED ROCK SKIP

The information contained herein was furnished by Theodore Hanan, Flory Manufacturing Co., Bangor, Pa.

Bituminous Filler for Granite Block

Asphalt mastic filler for granite block pavement has proved so satisfactory, states C. D. Pollock, consulting engineer, New York City, in a paper presented at the City Paving Conference in Philadelphia, Pa., Oct. 20-21, 1921, that the crude methods of use which now prevail should be eliminated. The present hand mixing methods are inexact. Mechanical mixing is an improvement, but of measuring the materials in order that the amount of sand used shall be uniform. It is also desirable that tests be made to determine more accurately the proper amount of sand to use. This amount should be as great as possible and still permit the mixture to flow readily into the joints.

NEWS OF THE WEEK

New York, November 24, 1921

Jubilee of American Public Health Association

Founder Present and Honored—Sanitary Engineering Section Meets With Am. Soc. C. E.

The semi-centennial celebration of the American Public Health Association was held in New York City, Nov. 14-18. Coincident with this meeting was the Health Exhibition and preceding it by a week was the Public Health Institute, both previously announced in these columns. The institute, which was largely attended, consisted of demonstrations of many and various lines of public health activity and of sanitary engineering works in New York City and vicinity.

A unique feature of the convention was the presence of Dr. Stephen Smith, one of the founders and the first president of the association, who is now in his ninety-ninth year, as noted in a biographical sketch elsewhere in these columns.

As has been customary, the association, as a whole, met in a few general sessions, but the vast mass of work was done through numerous section meetings—sanitary engineering, laboratory, vital statistics, public health administration, sociological, industrial bygiene, food and drugs, child hygiene, and health education and publicity.

Two Main Features

Features of the two main general sessions were (1) reviews of public health history during the last fifty years, in which sanitary engineering was presented by George W. Fuller, consulting engineer, New York City; quarantine, by Hugh S. Cumming, Surgeon-General, U. S. Public Health Service; bacteriology, by Edwin O. Jordan, professor of hygiene and bacteriology, University of Chicago; and public health work in Cuba, Mexico and Canada, by representatives of those countries. (2) An address on "European Health Conditions" by Prof. C. E. A. Winslow of Yale University.

Among the many business items affecting the whole association of chief interest were the announcement of the choice for new president of Dr. A. J. McLaughlin, of the U. S. Public Health Service, Washington, D. C.; the selection of Cleveland, Ohio, as the next meeting place; and a revision of the constitution of the association.

Sanitary Section Officers

The officers for the ensuing year chosen by the Sanitary Engineering Section include W. H. Dittoe, chief engineer, Ohio State Department of Health, as chairman; C. A. Emerson, Jr., engineer, Pennsylvania State Department of Health, vice-chairman; E. B. Rich, engineer, State Board of Health, Lansing, Mich., secretary (re-elected); and Theodore Horton, chief, Sanitary Engineering Bureau, Office of State Engineer, Albany, N. Y., section representative on the board of directors of the association.

(Continued on p. 870)

California to Offer Road Bond Issue of $7,000,000 At Once

The California state highway finance board has announced that $7,000,000 worth of state highway bonds will be offered for sale at Sacramento, Cal., Dec. 22. Because of the high premium commanded by the $5,000,000 block recently sold, as reported elsewhere, the interest on the new issue will be only 5 per cent. The proceeds of this sale will be used as part of the 1922 construction program which is expected to amount to a total of $18,500,000.

Rejects Commission-Manager Plan at Lockport, N. Y.

The commission-manager plan was defeated at Lockport, N. Y., Nov. 8, by a popular vote of 2,662 to 2,325, this being the third adverse vote.

Buffalo Votes for Water Filters

Buffalo, N. Y., on Nov. 8, voted 39,381 to 26,509 for a water filtration plant "at an estimated cost of $4,000,000, not to exceed $4,500,000." The plant will have a capacity of 160 m.g.d. and will be located near the Francis G. Ward pumping station. It will probably be six or eight months before plans will be ready for bidders. George C. Andrews is water commissioner and Arthur W. Kreinheider is commissioner of public works.

To Relieve New York Transit Jam By Staggered Work Hours

Following a report by Daniel L. Turner, its consulting engineer, the New York Transit Commission last week announced a plan of relieving traffic congestion on the city's rapid transit lines during the rush hours by urging employers to adopt a "staggered" schedule of opening and closing hours for their stores and offices. A classification of industries is to be made.

Summarizing the need of facilities sufficient to increase the capacity of the transit lines 60 per cent, Mr. Turner says:

"Contracts covering all of the city-owned rapid transit lines in operation have cost the city and companies together to produce to date approximately $454,000,000. Sixty per cent of this is $272,000,000. A large portion of these facilities were constructed under pre-war prices. To reproduce them now would probably cost at least $500,000,000. Therefore, spreading the traffic peak evenly over two hours, morning and night, would in this sense increase the capacity of the existing facilities as much as new facilities costing perhaps from $200,000,000 to $300,000,000 would represent."

But Mr. Turner says that a 40-per cent increase in capacity would be sufficient to meet a 5-year traffic increase.

Agree on Variety Limits for Paving Brick

Eleven Varieties Out of Sixty-six Believed Ample for Most Needs, Manufacturers' Report Shows

Responding to an invitation of the Department of Commerce, representatives of paving brick manufacturers and engineering societies met in Washington Nov. 15 and agreed upon limiting the number of varieties of paving brick to 11. These 11 standard varieties are to be presented for approval to the organizations represented. The conference agreed on the formation of a permanent committee, with its executive member in the Department of Commerce, to which will be entrusted the duty of following up the action taken at the meeting and also of furnishing machinery whereby questions of further simplification may be considered.

Among the organizations represented were the National Paving Brick Manufacturers Association, the American Society of Civil Engineers (by Col. W. D. Uhler), the American Society for Testing Materials (by W. E. Emley), the American Society for Municipal Improvements (by George F. Fish), the American Association of State Highway Officials (by Leon C. Herrick), Western Society of Engineers (by John A. Dailey), a number of government bureaus, and half a dozen other engineering societies.

Report Gives Facts

An excellent survey of current varieties of paving brick made by the secretary of the paving brick association, M. B. Greenough, formed the groundwork of the meeting. The survey disclosed 66 current varieties. A summary of the more important facts disclosed is printed elsewhere in this issue.

In the plain wire-cut class 92½ per cent of all shipments this year was in two sizes—4 x 3 x 8½ in. and 4 x 3½ x 8½ in. The other 7½ per cent of the shipments was in the remaining six varieties. In the repressed lug class 79½ per cent was in the 3½ x 4 x 8½-in. variety, and 20½ per cent in the 22 other varieties. Shipments were also strong in the 3 x 4 x 8½-in. and the 3½ x 3½ x 8½-in. varieties.

In the other classes of brick the sharp demarcations shown in the class already referred to did not obtain.

In preliminary deliberations in the full conference the elimination of 46 varieties was agreed upon. These went out as a result of resolutions eliminating all brick which were less than 3 or more than 4 in. in depth, less than 3 in. in width, and which were not 8½ in. in length. The matter of further eliminations were then referred to a committee with instructions to report at the afternoon session.

The committee's report eliminated 9 varieties in addition to those which had been eliminated in the full conference. The committee stated that it had

approached the subject with the desire of eliminating all sizes except those which could be cut from a 3-in. or a 4-in. clay column. On discussion, however, it was apparent that engineering practice is running rather strongly in the direction of using a brick 3½ in. deep, and the committee therefore concluded that brick of a 3½-in. depth would have to be provided for. State highway departments, for example, while finding that a 3-in. brick is too light for their use, find it unnecessary to go to the 4-in. depth which city paving practice demands.

In recommending the elimination of a 3 x 4 x 8½-in. repressed lug brick, the committee explained that while 5,000,000 of this brick were shipped this year, up to Aug. 1, its elimination was recommended because no hardship was imposed by asking users of this brick henceforth to substitute the 3½ x 4 x 8½-in. brick instead. No saving in freight is made by the use of the smaller size, which is identical in depth but is ½ in. narrower than one of the standards approved.

The committee recommended that all special brick, with two exceptions, be non-standard. The exceptions are one standard size in the Dunn hillside brick and one in the repressed hillside brick.

Eliminations

Before discussing the varieties in detail the conference unanimously adopted a resolution to the effect that reduction in number of varieties was in the interest of both consumer and manufacturer.

The sizes recommended for adoption by the committee and approved by the conference are as follows:

Plain wire-cut (vertical fiber lugless): 3 x 4 x 8½ in., 3½ x 4 x 8½ in.

Repressed lug: 3½ x 3½ x 8½ in., 3½ x 4 x 8½ in.

Vertical fiber lug: 3 x 4 x 8½ in., 3½ x 4 x 8½ in.

Dunn wire-cut lug: 3½ x 3 x 8½ in., 3½ x 3½ x 8½ in., 3½ x 4 x 8½ in.

Dunn hillside: 3½ x 4 x 8½ in.

Repressed hillside: 3½ x 4 x 8½ in.

The manufacturers' representatives stated that the manufacturers would stand ready to supply the necessary eliminated sizes and varieties required for repair work.

The committee believed that, eventually, additional elminations should be made, but that it was undesirable to attempt to reduce the number of varieties further at the present time.

Permanent Committee

It was voted that the following organizations be asked to designate representatives to serve upon the permanent committee.: American Society of Civil Engineers, American Society for Testing Materials, National Paving Brick Manufacturers Association, American Society for Municipal Improvements, American Association of State Highway Officials, Federated American Engineering Societies, Bureau of Standards, Department of Commerce, Bureau of Public Roads, U. S. Chamber of Commerce.

At the conclusion of the meeting general satisfaction with the character of the proceedings was expressed by Mr. Greenough on the part of the paving brick manufacturers, by R. Keith Compton (sitting for American Engineering Council) representing the engineers, and by F. M. Feiker, assistant to the Secretary of Commerce, on the part of the Department of Commerce. Frank B. Dunn, president of the Dunn Wire-Cut Brick Co., in expressing his approval of the work of the conference, stated that if the royalty on the Dunn patents stood in the way of further simplification he was ready to put the question as to what constituted a proper royalty into the hands of a committee for decision.

Centenarian First President of Public Health Association

Dr. Stephen Smith, founder and first president of the American Public Health Association, who lacks one year of being 100 years old, was the center of interest on several occasions during the fiftieth annual convention of the American Public Health Association in New York City last week.

Dr. Smith was born in Onondago County, N. Y., Feb. 19, 1823, and received the degree of M.D. from the College of Physicians and Surgeons (Columbia), New York City, in 1850. For some years after graduation he was surgeon and later consulting surgeon to hospitals in New York City. Between 1861 and 1874 he occupied various chairs of surgery and anatomy in medical schools in New York City, and during the last part of that period he was the editor of two different New York medical journals.

In 1865 Dr. Smith made a notable report on sanitary conditions in New York City. Following the submission of this report to the State Legislature Dr. Smith was appointed on the New York Metropolitan Board of Health, which for several years had jurisdiction over New York City and adjacent territory. Subsequently Dr. Smith was Commissioner of Health for New York City alone, and also a member of the short-lived National Board of Health. Besides some medical books, Dr. Smith wrote "The City That Was," which was devoted largely to the sanitary campaign in New York City that resulted in the creation of the Metropolitan Board of Health already mentioned (reviewed in *Engineering News*, Oct. 17, 1912, p. 744).

A bronze medal was presented to Dr. Smith at a banquet given in his honor at the convention of the American Public Health Association in New York City last week.

Highway Progress in Washington

According to a recent statement by James Allen, state highway commissioner for the state of Washington, plans and estimates have been prepared, and 60 contracts have been let for a total of 323.58 miles of improvements in the Washington State Highway system since the adjournment of legislature last March 10. The sum total of the contracts is $6,630,000, including 95.69 miles of paving, 197.07 miles of grading and graveling, 46.82 miles of graveling and eight bridges, practically completing the state road program for the year.

Bascule Bridge Failure at Soo

On Oct. 6 the double-leaf Strauss bascule bridge of the Canadian Pacific Ry. over the canal at Sault Ste. Marie, Mich., developed a rupture of the bottom chord of one of the counterweight parallelogram trusses. Railway traffic was interrupted for six days while the leaf was being brought back to closed position by jacking the counterweight. Navigation has since been maintained through the undamaged leaf.

The engineers of the railway company and of the Strauss company are making a joint examination to determine all the facts in the case and decide upon the nature of the permanent repairs. The latter will be carried out when navigation closes.

Survey Canadian Drainage Project from Airplane

The Reclamation Service of the Canadian Government has just completed a survey, by airplane, of a drainage project in the region of the Carrot River, on the boundary between Northern Manitoba and Saskatchewan. The project involves the reclamation of 800,000 to 900,000 acres of land. Much of the area was said to be inaccessible on account of floods.

The engineers of the service are said to have been impressed with the large amount of valuable data secured from the airplane pictures in a comparatively short time. Such surveys, the Canadian authorities point out, are mainly for reconnaissance purposes, and are not to be considered as superceding ground surveys with the usual engineering instruments.

Public Health Convention

(*Continued from p. 869*)

Committee chairmen of the Sanitary Engineering Section for the ensuing year are: Water Supply and Purification, George W. Fuller; Sewerage and Sewage Treatment, W. L. Stevenson; Waterways Sanitation, C. A. Emerson, Jr.; Refuse Disposal, M. N. Baker, Mosquito Extermination, M. Z. Baer; Bathing Places, G. W. Symonds, Jr.; Milk Supplies, H. A. Whittaker; Air, George A. Soper; Constitution, Paul Hansen.

Besides its own technical papers and committee reports, the members of the Sanitary Engineering Section shared in the proceedings of the health conference of the American Society of Civil Engineers, which occupied an afternoon and two evening sessions, at which a large number of addresses, remarkable for their conciseness and comprehensiveness, were presented by specialists in the fields of sewage treatment, the control of offensive odors, and water supply and treatment. Notwithstanding the number of addresses on these subjects, there was ample time for general discussion, so well did the authors of the addresses confine themselves to the time limit set. A stenographic record of the general discussion was made, so presumably the addresses and the general discussion will be published by the American Society of Civil Engineers. A summary of the health conference proceedings, and of some of the technical papers before the Sanitary Engineering Section of the American Public Health Association, will be printed in *Engineering News-Record* next week.

Begin Work Under New Federal Road Act

U. S. Bureau of Public Roads Active in Starting Machinery For Highway Program

(Washington Correspondence)

No sooner had the federal-aid highway bill become a law on Nov. 9 than work was begun at once by the U. S. Bureau of Public Roads to complete the necessary preliminaries for certain important highway projects in an effort to relieve unemployment. All red-tape was cut and the details are to be worked out later after the regulations for the administration of the new law will have been perfected.

The work on the regulations is being hurried so that a complete draft may be ready to submit to the American Association of State Highway Officials at its convention, in Omaha Dec. 5-8. It is the intention to secure the criticisms and suggestions of these officials and others interested before promulgating the regulations. Thomas H. MacDonald, chief of the bureau, states that the highway program is a partnership arrangement between the federal government and the several states, and that there will be no high-handed efforts on the part of the federal government in administering the new act. He points out that the states are furnishing half of the funds and have direct supervision of all the work and as a result they will have every opportunity to be heard before any administrative regulations are promulgated.

Maps of Systems Called For

The principal work in preparing the regulations relates to maintenance and classification of roads; all the states have been called upon to furnish a map showing their tentative road program.

Mr. MacDonald takes issue with the publication of statements that the new law was enacted just in time to save millions of dollars worth of federal-aid roads from going to pieces, due to lack of maintenance. He declares that in no single instance has any federal-aid road "gone to pot," as is being stated. The maintenance feature of the new law was inserted to meet a condition which might arise rather than to correct an existing situation. He attributes no small part of the maintenance work done under the old law to the fact that the facilities of the states to do repair work were enlarged materially by the distribution of $130,000,000 worth of the War Department's surplus property.

New Jersey Defeats $14,000,000 Bonds for Institutions

The voters of New Jersey voted down a bond issue of $14,000,000 for the improvement and enlargement of state institutions on Nov. 8.

Belle Isle Bridge Progressing

Pier construction for the Belle Isle bridge at Detroit is progressing at a rate that promises the completion of six piers by Jan. 1, according to H. H. Esselstyn, representing the designers for the bridge. Pier 15 has been completed up to the base of the steel work, the cofferdam of pier 16 has been unwatered ready for concreting the pier body, and the cofferdam for pier 14 has been sealed ready for pumping. Work on pier 18 is about to begin. In the two piers already unwatered, Mr. Esselstyn states, very little trouble was experienced in leakage through the cofferdams, and there was no indication of any trouble in sealing the bottom against the cofferdam walls, with 4½-ft. concrete base on top of the piles.

National Conference of A. G. C.

The annual conference of the Associated General Contractors of America is to be held in Cleveland on Jan. 17, 18 and 19, 1922. The program has not yet been announced.

Detroit Bridge Authorized By State Utilities Commission

Authority was granted Nov. 17 by the Michigan Public Utilities Commission for the sale of Detroit Bridge securities in the state, on the basis of a total issue of $5,000,000 stock and $15,000,000 bonds of 7 per cent, running 30 years, the stock to be sold at par and the bonds not below 87.

The American Transit Co, which will build the bridge in co-operation with a similar Canadian company working under a Dominion charter, has contracted with the R. T. Scott Co. of Toronto for the sale of the securities. Work on right-of-way surveys, triangulation and borings will go ahead at once. Pier construction is expected to begin next season, by which time also the review of the preliminary superstructure plans will be completed.

The structure to be built is an eight-cable suspension bridge of 1,803 ft. main span, with two decks, for highway and railway traffic respectively, of which only one deck is to be built at the start. W. B. Gregory, of Gregory, Mayer & Thom, is president of the company, and Charles Evan Fowler is chief engineer.

Specifications for Large Bridge in Australia Are Issued

Elaborate specifications have arrived in this country for the construction of a cantilever bridge across Sydney harbor, Australia, from Dawes Point to Milsons Point, bids on which will be received up to Oct. 31, 1922. The specifications and attendant data, in addition to a number of large drawings, fill a book of 115 legal-sized pages which cover even minutest details, including the composition and tests of materials as well as the erection of the bridge itself. However, all stress sheets, working drawings, etc., are to be prepared by the contractor. Announcement is made that J. J. C. Bradfield, chief engineer of the Department of Public Works, New South Wales, will travel through Canada in April and May, 1922, so that prospective bidders may consult with him.

The contract calls for "the manufacture, supply, delivery, construction and erection complete and ready for traffic" of a bridge with a total length of 3,816 ft. The main span is to consist of two 500-ft. cantilever arms and a central section, 600 ft. long, suspended from the ends of the arms, making a total length of main span of 1,600 ft. between pier centers. The height of the trusses over the main piers will be 270 ft. and the height of the central suspended section 100 ft. There will be no movable span, the clearance above high water level being 170 ft.

City Manager Progress and Problems Reviewed

Record Attendance at Chicago Meeting —Now 257 Manager Cities—Bond Limits—Revenue Sources

Almost everything that a public official encounters except engineering was discussed at the eighth annual meeting of the City Managers' Association held Nov. 14 to 16 in Chicago. Police, general administration, finance, welfare, general complaints and ideal attributes of a manager, together with a most spirited debate for and against the city-manager plan for large cities by opposing leaders in the recent Cleveland campaign, were the main topics.

The meeting was the largest yet held, more than 100 being in attendance, of whom about 50 were managers. The movement has gone forward consistently, said Harrison G. Otis, secretary, and now 257 cities, representing a population of 4,630,000, have adopted this plan. Six of the cities are in Canada; 184 operate under charters and 67 by ordinance. Cleveland is the largest city on the list but 49 cities have populations in excess of 20,000 and 103 range from 5,000 to 20,000. Forty cities having the commission form have changed to the commission-manager form. Only two cities, both small, have gone back to the mayor-council form; Brownwood, Tex., which did not have a standard manager form, and Hot Springs, Ark., which had acrid local political difficulties, large debt and an unsolvable liquor problem. Three city-manager charters have been put in force without a referendum: Nashville, Tenn., Clarksburg, Va., and Brunswick, Ga. There is no doubt as to how well they will turn out. Only three cities have home-town managers, the others obtaining out-of-town talent, which is considered far preferable since the manager then has not local prejudices or affiliations to bias his judgment or to hamper his activities.

Organization Aims

While the association assists those interested in the movement and acts as a clearing house for cities seeking managers, Mr. Otis was emphatic in his remarks that the principal aim and work of the organization is to help the members to a better performance of their duties through an interchange of information. In this work 19,000 pieces of mail were sent out by the executive secretary, including 4,500 letters, 2,000 year books, and 4,600 bulletins.

Bonds and Revenue Sources

In a brief paper on "Public Finance" by Charles E. Ashburner, Norfolk, Va., the manager longest in service, it was stated that there is practically no difference in principle between public and private financing. Particularly was he insistent on making the life of bonds co-terminous with the life of the improvements, classifications of which he gave as follows:

"Improvements of short life should in all cases be made from cash or short-term bonds. If from the latter, the bonds should be so arranged that the expiration period of the last bond does not occur at a date subsequent to the life of the improvement. For such equipment as fire apparatus, which soon becomes obsolete, bonds should run for from 5 to 10 years only. High grade

To Complete Alaska Railway

By a vote of 198 to 76 the House of Representatives Nov. 2, passed and sent to the Senate a bill carrying an appropriation of $4,000,000 to complete the construction of the Alaska Ry. A total of $52,000,000 has already been appropriated for construction of this road.

Federal Road Engineers To Meet

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, has called a meeting of the district engineers of the bureau to take place in Omaha during the week of Nov. 28. At that time the district Engineers will discuss the new highway act with Mr. MacDonald and the division chiefs in the Washington bureau. Most of the officials expect to stay in Omaha for the meeting of the American Association of State Highway Officials which begins Dec. 5.

City Managers' Convention

(*Continued from page* 871)

pavements with car tracks might be listed in the 15-year class while similar improvement without car tracks could easily stand a 20-year obligation. Sewers, buildings and bridges could be financed with 30-year bonds. Land, docks and water-works might very well carry a 50-year bond issue because land should always increase in value if purchased with proper foresight and no city would think of building either docks or water-works that would not have a value at any time during the 50 years at least equal to the outstanding obligation."

At the joint meeting with the National Municipal League, Luther Gulick, chairman of the League's Committee On Sources of Revenue, indicated that taxes rose from $11.50 per $1,000 in 1909 to $21.50 in 1919. The present problem is to "secure the most feathers with the least squawk." Points recommended by the committee are as follows: (1) While it is impossible to separate state and local sources, cities which do four-fifths of the service for the citizen should get a larger part of the taxes than they now do. (2) The extension of occupational taxes would be absurd but inspection fees should be increased. (3) Special assessments are sound and should be extended. (4) Taxing sign boards is sound. (5) With few exceptions limitation of taxes by state legislation is unsatisfactory. (6) In assessments of property 100 per cent of present day value should be used.

William A. Hough, a member of the Indiana tax commission, explained the operation of the 1920 laws by which the commission controls all bond issues. An engineering force is maintained by the commission to check up all issues as to cost and necessity. With reference to road bond issues by counties, townships or districts, Mr. Hough stated that the commission refused permission to their issue when it considered that the estimates were too high. He indicated that contractors' associations are promoting roads merely for the sake of the contracts to be obtained.

The newly elected officers of the City Managers' Association are as follows: President, C. M. Osborn, manager of East Cleveland, O.; vice-presidents, Charles E. Hewes, R. W. Rigsby and Fred H. Locke; executive secretary, H. H. Freeman, Kalamazoo, Mich.

Samuel M. Gray

Samuel M. Gray, consulting engineer, of Providence, R. I., whose death Nov. 5 was noted in these columns last week, was a widely recognized authority in the field of waterworks, sewerage and hydraulics. While the later years of his professional experience had been devoted exclusively to consulting work, Mr. Gray had served for 13 years as city engineer of Providence, and for 30 years was a member of the State Board of Health of Rhode Island.

A list of the works designed and constructed by him covers scores of cities, not only in the United States, but in Mexico and Canada, among his most important assignments being the design of the reconstructed water-works at Baltimore costing $2,000,000, the remodeling of the sewage treatment plant at Worcester, Mass., the design of Baltimore's large sewage treatment works and sewerage system, on which Mr. Gray was one of a board of three consulting engineers, the design of a complete system of intercepting sewers for the District of Columbia, and the investigation of the contamination of the water supply of Philadelphia, involving slow sand filtration works at a cost of $30,000,000.

Was Assistant to J. H. Shedd

Mr. Gray was born in Andover, Mass., in 1842 and after leaving school began his engineering career on railroad construction in Connecticut. Going to Providence in the early sixties, he secured a position as assistant to the late J. Herbert Shedd, then chief engineer for the new water supply for Providence.

His work received favorable notice and in 1877 he was selected city engineer of Providence, a position which he held for more than 13 years. His duties included also supervision over the departments of water-works, sewerage, bridges, and highways. While in that position the city sent him on an extended European trip for the study of sewage disposal methods, and he visited England, France, Germany, Italy, and Holland.

Mr. Gray resigned as city engineer of Providence in 1890 and opened an office as consulting engineer, specializing in municipal and sanitary work, and continued in this field almost up to the time of his death. During his thirty-one years of consulting practice he has been retained on water or sewerage works for Baltimore, Louisville, Ky., Havana, Monterey, Mexico, Toronto, San Antonio, Philadelphia, Worcester, Mass., Syracuse, N. Y., Binghamton, N. Y., and other cities.

In 1913, when over 70 years old, Mr. Gray was selected as engineer for the study of a new water supply for Providence and held that position until the general plans for the new work were developed. He was then retained as chief consultant up to the time of his death. In 1892 Mr. Gray served as vice-president of the American Society of Civil Engineers.

Railroads Cut Rates on Farm and Dairy Products 10 Per Cent

A reduction of 10 per cent in carload freight rates on farm products is to be put into effect immediately and without waiting for a reduction in wages, according to a recent announcement made from the offices of the Association of Railway Executives. The reduction is to apply throughout the United States, except on traffic moving wholly within New England. The reduction applies to certain grain and grain products, fruits, vegetables, cattle and hogs, and dairy products. Any reduction that has been made in such rates since Sept. 1, 1920, is to constitute a part of the 10 per cent reduction.

Federation's Annual Meeting To Be Held Jan. 5 and 6

The annual meeting of the American Engineering Council of the Federated American Engineering Societies will be held in Washington, D. C., Jan. 5 and 6, according to an announcement just made by L. W. Wallace, executive secretary, who says in part:

"The Executive Board should give serious consideration to methods of informing engineers as to the aims, policies and activities of the federation. Some member societies have been and are now, perhaps, rather indifferent to a continuation of their affiliation. As far as we have been able to ascertain, this condition is due to the officials and the members of such organizations not being fully informed.

"While it may be true that during the first years the federation has not been able to accomplish all that was expected on the part of some and that it has not fully found itself, so to speak, yet the progress has been such as to justify optimism rather than pessimism as to the future usefulness of the federation. The federation has been fairly well established in the minds of the public and in government circles. This is evidenced by the character and quantity of publicity that the federation has received."

General Activities

The general activities of the federation during the year, according to Mr. Wallace, have included the following: Assistance in organizing a conference of engineers to consider the advisability of fall letting of highway construction contracts; co-operation in arranging for the Unemployment Conference; promoting the movement for a National Department of Public Works; appointment of a committee to frame a plan for a permanent employment service; adoption of a policy to avoid confusion and antagonism on the question of licensing of engineers; conferences with a committee of the American Association of Engineers; investigation by Committee on Elimination of Waste in Industry; establishment of a federation bulletin and digest service.

The federation has now more than 43,000 members. President Mortimer E. Cooley and Mr. Wallace are now carrying out plans for more intensive organization, aiming particularly to link up the member societies in a more cohesive scheme of action so that the influence and benefits of the federation may be more directly and systematically communicated to the societies.

Indianapolis Plans Public Works Program Under New Engineer

Lew Shank, mayor-elect of Indianapolis, has directed John L. Elliott who, he has announced, will be city civil engineer in the next administration, to make a survey of the city and determine what public improvements are most needed. Many additions to the city's sewer system in both the downtown and residence districts will be necessary soon, according to Mr. Elliott, and this may be a part of the work determined on for the next four years, The rapid growth of the city to the north has given too great a load for the capacity of the sewer system in the central part of the city. It may be necessary to construct relief sewers in the downtown district, or provide for storm overflows into Pogue's Run sewer. Within the next year a large new sewer system in the northern part of the city and Broad Ripple, will be placed in use, and this will add to the overload now carried in the central part of the city.

The general program of track elevation for the east, south and west parts of the city, Mr. Elliott believes, should be pushed as rapidly as the financial condition of the railroads will permit.

Associations Call Conference on Standard Contracts

Means for bringing about uniform contracting practice and standard contracts will be discussed at a conference in Washington, D. C., Dec. 15, 1921, in which leading engineering and contracting associations will participate. In the call for the conference it is urged that standard contracts will reduce legal expenses, decrease duplication of work, eliminate dispute, safeguard owners, increase public confidence and raise the standard of construction service.

It is thought that standardization can be approached by a segregation of general and special contract principles, placing those which pertain to all work in a standard document. Such a primary document would convey to everyone the main governing principles of construction obligations, leaving the secondary and complementary document the special stipulations. The first can be selected and approved by all of the technical societies and the second can be drafted by those best able to speak for an individual field of construction.

When the process of standardization has been carried out the field of construction contracts would then be covered by (1)) The universal document for all work, preferably called The Agreement; (2) several sets of special principles, one for each type of work, for example, one set for railways, another for buildings, another for waterworks, and so on to the desired extent. These documents might preferably be designated "The General Conditions" of each type.

The associations co-operating in the conference are: The American Association of State Highway Officials; the American Engineering Council; the American Institute of Architects; the American Railway Engineering Association; the American Society of Civil Engineers; the American Water Works Association; the Associated General Contractors of America; the National Association of Builders' Exchanges; and the Western Society of Engineers.

Further Amendments to Civil Engineers' Constitution

The American Society of Civil Engineers is sending to its corporate members notice of the proposal of amendments to the new constitution, which was adopted by letter ballot last month. The amendments are in two groups, those fathered by the Board of Direction and the now expired Committee on Referred Amendments, and those proposed by a number of members headed by Richard L. Humphrey and made up largely of men from Philadelphia.

The first group, three in number, merely provides for formally taking care of omissions in the constitution as adopted, and, with reference to the nomination of officers, for definitely limiting the counting of ballots by district and zone limitations to the first and second canvasses, thereby preventing the possible interpretation that such limitation applies also to the final ballot.

The amendments fathered by the group headed by Mr. Humphrey would, (1) remove the members not residing in North America from District No. 1; (2) substitute for the ballot primaries a series of district and zone nominating boards; (3) establish an annual conference of representatives of local sections, to which mileage would be paid by the parent society for one representative from each section; (4) allocate each member of the society to some local section and make it obligatory on the Board of Direction to allocate to each section an annual sum from the funds of the society.

In the proposed new method of election the candidates nominated by the district and zone nominating boards, plus additional nominations made by declaration on which local sections would have voting power in proportion to their respective memberships, would be voted upon by the corporate members in the respective districts and zones. The candidate getting the highest number of votes would be certified to the annual convention of representatives of local sections, which convention would nominate the candidate for the presidency.

Trucks Start to Destroy Test Concrete Road

Thirty-six 5-Ton Units Begin Journey Around Track at Pittsburg, Cal.

Traffic was started Nov. 9 on the experimental concrete road at Pittsburg, Cal., which is to be tested to destruction by motor trucks. For use in the test the U. S. Bureau of Public Roads supplied 18 trucks with drivers and another 18 trucks were donated by the California Highway Commission. Two California highway commissioners, representatives of automobile associations, and about one thousand spectators, including a large percentage of engineers, witnessed the start of the test. A description of the experimental road and its purpose appeared in *Engineering News-Record*, Aug. 18, 1921, p. 276.

All the trucks were of 5-ton capacity, equipped with solid tires and loaded with pig iron to give a gross weight of 14,500 lb. each. They are to be operated 8 hours per day until the life of the thirteen various types of pavement is determined. Eighteen of the trucks travel around the elliptical roadway in one direction and the other eighteen in the opposite direction at an average rate of 10 miles per hour, thus each truck makes about 40 trips per hour and each section of the pavement will be traversed 11,520 times per 8 hours.

By means of gages and integrating devices in tunnels beneath the pavement, records are being made of the deflections in various sections of the concrete slab and subgrade, temperature readings are being recorded and by means of lines dividing the entire pavement area into 6-ft. squares a progressive record will be kept of surface conditions

Trend of Engineering Employment Shows Improvement

A tangible indication that the demand for engineering services is increasing comes from the employment report for October of the American Association of Engineers. During the month almost the same number of men registered for employment as during September but of these only 45 per cent were actually unemployed, which is 10 per cent less than for September. More positions were received and more men placed all over the country than in the previous month. The following table shows the trend.

	October, 1921	September, 1921	October, 1920
Applicants for employment	1,877	1,749	1,602
Positions received	384	348	694
Men referred	1,731	1,861	3,357
Men placed	240	213	301

The average salary of positions filled in October was $186, or $2 more than last month. For the same month last year it was $203. The oldest man that registered was 68 and the youngest 18. The average age was 36 and the average years of engineering experience was more than 10. The highest salary desired was $12,000 and the lowest $90 a month. The average salary applicants would consider was $210 a month. Of the men registered for employment 61 per cent were university graduates; 40 per cent were classified under civil engineering positions. The greatest demand for engineers was in appraisals, industrial and public utilities, structural and architectural designing. The demand for construction engineers was small.

California Highway Bonds Sold At Premium

A $5,000,000 block of California State highway bonds bearing 5½ per cent interest were offered for sale at public auction in Sacramento, on Oct. 27. A large number of San Francisco banking houses were represented and after spirited bidding the bonds were sold to the Anglo & London Paris National Bank of San Francisco at a premium of $476,-

000. After the sale state officers stated that under present conditions these bonds would have found a market if their interest rate had been as low as 5½ per cent.

The interest rate on each block of California highway bonds is now fixed by a commission just before the block is put on the market. The plan was described in *Engineering News-Record*, Nov. 11, 1920, p. 962.

Road Builders Elect Officers and Change Constitution

At the annual meeting the American Road Builders' Association held in New York City, Nov. 15, officers for the ensuing year were elected as follows:

President, H. L. Bowlby, chief, War Materials Division, U. S. Bureau of Public Roads; vice-presidents, Charles J. Bennett, State Highway Commissioner of Connecticut, New Haven, Conn.; Frank Page, chairman, North Carolina State Highway Commission, Raleigh, N. C.; A. R. Hirst, State Highway Engineer of Wisconsin, Madison, Wis.; W. W. Crosby, National Park Service, Estes Park, Colo.; secretary, E. L. Powers, Editor, *Good Roads*, New York, N. Y.; Treasurer, Senator James H. MacDonald, former State Highway Commissioner of Connecticut, New Haven, Conn.

Several changes to the constitution and by-laws of the association were approved, the most important being a change in the date of the annual meeting from November to May and a change in the method of electing officers. Under the new provisions officers will be elected from among the directors by the directors. Vacancies on the board will be filled each year by a nominating committee of seven selected from the board of directors. Another change makes the president eligible for re-election. By holding the annual meeting in May, the new officers will have a longer time in which to lay plans for the annual convention and exposition. Arrangements were made to hold the next good roads congress and show at the Coliseum in Chicago, Jan. 17 to 20, 1922.

Department of Commerce Names Zoning Committee

In order to make available a concensus of opinion regarding good practice in zoning ordinances the U. S. Department of Commerce has organized a committee to inquire into and report on the subject. Its importance is indicated by the adoption of zoning laws by 40 cities and towns and the consideration of such laws by 70 additional municipalities.

The membership of the committee and the organizations represented follow:

Louis A. Moses, National Association of Real Estate Boards; J. Horace MacFarland, American Civic Association; Nelson P. Lewis, National Municipal League and National City Planning Conference; Lawrence Veiller, National Housing Association; Morris Knowles, of Pittsburgh; Edward M. Bassett, chairman Zoning Committee of New York; Frederick Law Olmstead, president, Society of Landscape Architects; and John Ihlder, U. S. Chamber of Commerce.

John M. Gries is chief of the department's Division of Building and Housing, under which the committee acts.

Discussion of Joint Committee's Concrete Specifications

The program of the two-day discussion of the Standard Specifications on Concrete of the Joint Committee of Concrete and Reinforced Concrete, is as follows:

Dec. 7.
9 a.m. Chap. IX. Waterproofing and protective treatment.
Chap. X. Surface finish.
2 p.m. Chap. VI. Depositing concrete.
Chap. VII. Forms.
Chap. VIII. Details of construction.
8 p.m. Chap. XI. Design.

Dec. 8.
9 a.m. Continuation of discussion of Chaps. VIII and XI.
2 p.m. General discussion of the tentative specifications for concrete and reinforced concrete and of the scope of the Joint Committee's work.
8 p.m. Chap. III. Quality of concrete.
Chap. IV. Materials.
Chap. V. Proportion and mixing concrete.

Under the auspices of the American Society of Civil Engineers.

PLACE. — Engineering Societies Bldg., New York City.

TIME. — December 7 and 8.

California Road Contract Sought By Twenty-Two Firms

Sharp competition characterized the bidding for the first 7½-mile section of the Ocean Boulevard, which, when completed throughout, will connect the coast highway between Oxnard and San Juan Capistrano, and give Southern California 250 miles of uninterrupted coast-line highway. Twenty-two contracting firms submitted bids to the California Highway Commission for this work, which included grading a 40-ft. section and paving with cement concrete 20 ft. wide 6 in. thick, reinforced with steel rods. The bids ranged from $445,864 to $260,739. The engineer's net estimate on this section was $286,227.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

The Colorado Section, Am. Soc. C. E., at its monthly dinner and meeting in Denver, Nov. 14 heard H. L. Thackwell propose a plan for the construction of a ten-story Engineers Building in Denver for the use of consulting engineers and architects. A committee was appointed to investigate the feasibility and outline a scheme for financing the project. The meeting also endorsed the bill now pending in Congress providing for the commissioning of sanitary engineers in the U. S. Public Health Service. R. H. Fox, expert on bearings, gave a lantern slide lecture on the "Development and Application of the Ball Bearing."

The Providence (R. I.) Engineering Society, at its meeting Nov. 15 was addressed by Alfred D. Flinn, secretary, United Engineering Society and Engineering Foundation and chairman, Division of Engineering, National Research Council, on "The Engineer's Road to Peace: Co-operation, Past, Present and Future."

The Engineers' Club of Cincinnati and the Cincinnati Section, Am. Soc. C. E., held a joint meeting Nov. 17 which was addressed by Ralph N. Begien, general manager, Baltimore & Ohio R.R., whose subject was "The Immediate Future of Railroad Development."

The Jackson (Mich.) Engineering Society, at its meeting Nov. 7, was addressed by Prof. A. C. White, director of engineering research at the University of Michigan.

The New York Assembly, A.A.E., at its meeting Nov. 12 in Albany, elected the following officers: President, Germain P. Graham; vice-president, G. P. Hevenor; second vice-president, W. L. Everett; secretary-treasurer, J. G. Brennan.

The New Jersey Association of County Engineers held its Fall meeting and inspection Nov. 18 and 19, with Delaware, Pennsylvania and New Jersey state highway engineers as guests. Highways in Mercer, Middlesex, Monmouth and Burlington counties were inspected. One of the subjects under discussion at the evening session Nov. 18 was the advisability of counties building part of state highway system under the reimbursement act, as proposed by State Highway Commission.

The Eastern Paving Brick Manufacturers Association will hold its annual meeting at the Pennsylvania Hotel, New York City, Dec. 13 and 14.

The Utah Society of Engineers, at its meeting Nov. 16, in Salt Lake City, was addressed by B. J. Finch on "Utah's Highway Needs."

The Iowa Section, Americal Water Works Association at its annual meeting Nov. 1, 2 and 3 in Omaha, elected the following officers: Chairman, J. Chris Jensen; vice-chairman, Peter Kern; directors, Harvey P. Letton and C. L. Ehrhart; secretary-treasurer, Jack J. Hinman, Jr., Iowa City.

The Municipal Engineers of the City of New York, at a meeting Nov. 22, was addressed by Daniel L. Turner, consulting engineer to the New York Transit Commission on "Moving Platforms." He discussed the problem of relieving transfer congestion between the east and the west side subways at 42nd Street, New York. H. S. Putnam, consulting electrical engineer discussed the electrical carrier system as adapted to the operation of moving platforms.

PERSONAL NOTES

L. E. BARKER, formerly engineer for the Pima County (Ariz.), Highway Commission, has been appointed engineer with the Yavapai County Highway Commission.

GEORGE A. MCCLELLAND, formerly district engineer of the Texas Highway Commission, has been appointed engineer of Harrison County, Tex.

IRA W. MCCONNELL, vice-president and chief engineer for Dwight P. Robinson & Co., Inc., engineers and contractors of New York, is in South America, where he will be engaged for a number of months on the company's construction projects in Brazil. The work includes the construction of a number of dams.

H. E. SURMAN, formerly district engineer at Dixon, Ill., with the Highway Division of Illinois Department of Public Works and Buildings, in charge of the planning, construction and maintenance of state roads in the district, has been appointed engineer of design with the department, succeeding Frank T. Sheets, and will have charge of the planning of all state roads, with headquarters at Springfield. Mr. Sheets' promotion to superintendent of highways was noted in these columns Sept. 29, p. 542.

HOWARD M. SMITTEN, assistant engineer in the valuation department of the Southern Pacific, has been appointed bridge engineers of the Western Pacific R.R., with headquarters at San Francisco.

HARRY P. GRIER, of Statesville, N. C., county engineer for Iredell and Alexander counties, has been appointed district engineer for the Asphalt Association, with headquarters in Raleigh, N. C.

JOHN P. LEO, has resigned as commissioner, Department of Street Cleaning, New York.

E. P. JOHNSON, formerly division engineer, Section 1, Welland Ship Canal, has been appointed division engineer, Section 5, in which capacity he will also have supervision of survey work and plans for Sections 6 and 7. His headquarters will be at Welland.

BARTON M. JONES, for 7 years connected with the Miami Conservancy District at Dayton, Ohio, recently as division engineer having direct supervision of the construction of the Lockington dam, has been given local charge, by the Dayton Morgan Engineering Co., of the flood prevention work at Pueblo, Col.

CARL T. BOWEN, for the past two years connected with the Michigan State Highway Department, has been appointed engineer and superintendent of roads in Ottawa County, Mich.

H. E. BRENCHLEY, structural contracting manager of the Minneapolis Steel & Machinery Co., New York, has been elected vice-president of the Structural Steel Society at its meeting in Chicago, Nov. 8.

HERBERT ABRAHAM, chemical engineer and chairman of the Technical Committee of the Prepared Roofing Association, Chicago, has been appointed a member of the technical committee of the Asphalt Association, New York.

F. A. DAVIDSON, of the Dwight P. Robinson Co., of New York City, has been elected chairman of the construction section of the National Safety Council.

H. W. FORSTER, of the Independence Bureau, Philadelphia, has been elected chairman of the engineering section of the National Safety Council.

J. W. BEARDSLEY has resigned as engineer member of the Highway Commission of the Republic of Panama. This position includes the duties of chief engineer and of executive officer of the commission. He was formerly director of public works, P. I., and chief engineer of the Porto Rico Irrigation Service.

JOHN L. ELLIOTT, now senior assistant city civil engineer, of Indianapolis, has been appointed city civil engineer by Lew Shank newly elected mayor. Mr. Elliott replaces Frank C. Lingenfelter, for whom no place has been provided in the Shank administration.

ERNEST F. NICHOLS, president of the Massachusetts Institute of Technology, has resigned his office because of ill health, and his resignation has been accepted by the executive committee of the corporation. He has been given a leave of absence until Jan. 4, 1922, when the next meeting of the corporation will be held and the action of the executive committee will be ratified.

MOSELEY & FOUNTAIN is a firm of consulting, designing and supervising engineers recently organized with offices in Dallas, Tex., by Hal Moseley, for two years city engineer of Dallas, and, later, commissioner of public works of Dallas, and by Thomas L. Fountain, for five years senior member of the firm, The Fountain-Shaw Engineering Co., Dallas, for two years engineer of sewerage for Dallas, and recently principal assistant engineer with J. D. Trammell, consulting engineer, Fort Worth, Tex. Both members of the new firm served as captains, Engineers, with the A. E. F. in France.

R. K. WEST, formerly principal assistant engineer California Highway Commission, and later chief engineer of highways of Nevada and, during the war, captain, Engineers, A. E. F., has been appointed acting chief engineer of the highway commission, Republic of Panama.

OBITUARY

I. T. GOODWIN, JR., of Athens, Ga., division engineer, Georgia Highway Department, was killed in an automobile accident, Nov. 9, while on an inspection tour of roads near Covington, Ga. He was graduated from the University of Georgia in 1912 and was a veteran of the World War.

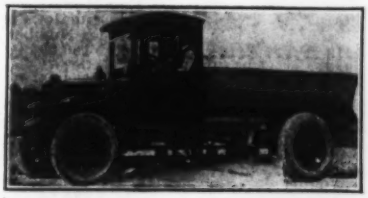
WILLIAM GRACE, president William Grace Co., contractors, Chicago, died Nov. 6, at Barrington, Ill. He was borne in Hull, England, in 1847 and came to this country in 1871. Early in life he was associated in Chicago with John Griffiths and F. D. Hyde. Mr. Grace built the La Salle St. station, the county building, and many other large buildings in Chicago and New York.

G. PRESTON BRADY, civil engineer, at one time connected with Campbell & Lattimore, contractors on the foundation work for the High Level Bridge at St. Catherines, Ont., and later engaged in drafting work for the Pere Marquette Ry. in connection with valuation work was killed in a street accident in Troy, N. Y., recently.

EQUIPMENT AND MATERIALS

Motor Truck with Scraper Blade

A scraper attachment for maintaining gravel roads is being attached to its 2½-ton special road maintenance truck by the Republic Truck Sales Corporation of Alma, Mich. Lighter trucks can be equipped but the size



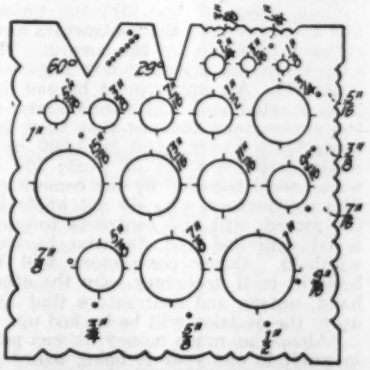
named has the pulling power and weight which seem best suited to efficient operation of the scraper.

The scraper is a blade edged with ⅜ x 2 in. steel mounted on four steel springs 6 in. wide, which are mounted on a round, hollow bar which is adjustable by means of a chain and ratchet post. The bar is mounted on a 2 x 6 in. oak timber through adjustable brackets, and this timber is then mounted on the chassis frame, with brackets and braces. When not in use the scraper is raised and gives a clearance of 8 in. under the lowest point.

An operating speed of 8 to 12 miles per hour gives the best results. Several of these trucks have been working this season on gravel roads in Kent County, Michigan.

Useful Drawing Board Device

A device to aid the draftsman in drawing screw threads, nuts, fillets and circumferences without using rules,



compass and tables is being sold by the Lopez Manufacturing Co., Chicago, Ill. With the device, screw nuts from ⅛ to 1 in.; circumferences from ⅛ to 9⅛ in.; 60 deg. screw threads; 29 deg. Acme threads, and radius and fillets corresponding to the circumferences, can be drawn directly. The device is made of transparent material and is 4¾ in. square.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Engineering News-Record's Cost Index for 1920 and 1921

Engineering News-Record's Construction Cost Index Number is being computed monthly back to 1913, and each week a year's figures will be published in these pages. The Numbers from January, 1920, to November, 1921, are given in the following tabulation, and the figures are plotted in the chart accompanying the article on this page, entitled "Construction Industry Has Been Waiting for Steady Prices." The Numbers for the months of 1919 will be presented next week.

	Eng. News-Record Construction Cost Index Number
1913	100.00
1920	
January	206.55
February	225.10
March	240.85
April	265.20
May	268.90
June	273.80
July	265.65
August	252.00
September	255.20
October	255.20
November	255.32
December	251.62
1921	
January	230.87
February	230.67
March	224.27
April	213.02
May	210.82
June	209.82
July	203.82
August	193.07
September	188.27
October	182.57
November	166.32

Chicago Determines to Rid Itself Of Building Restrictions

So far as the carpenters, plumbers and five other trades are concerned Chicago is to be an open-shop city unless they accede to the Landis award. At a huge mass meeting sponsored by the Chicago Association of Commerce, T. E. Donnelly of the citizens committee to enforce the award and other representative business men, clearly indicated what would take place.

Only seven of the fifty-one unions and 15 per cent of the contractors have refused to abide by the award. The carpenters' union cannot now negotiate contracts. An employment bureau has been started and will furnish men to the contractors and see that they are protected. From 1,100 to 1,200 non-union carpenters are at work, 200 of whom were supplied by the committee. The contractors, who do not abide by the award, will find contracts for material cancelled and financial backing withheld. Other contractors will be brought in if necessary. On the other hand, unions and contractors that live up to the decision will be backed up.

"Almost as much money as was paid in graft in one year is being asked of the business men by the citizens committee to clean up the situation," said Mr. Donnelly.

We'll make this section what you want it to be—provided you tell us frankly what you want.

Construction Industry Has Been Waiting for Steady Prices

Contracts Let Shown in Terms of 1913 Purchasing Power—Chart Includes E. N. R. Cost Index Number

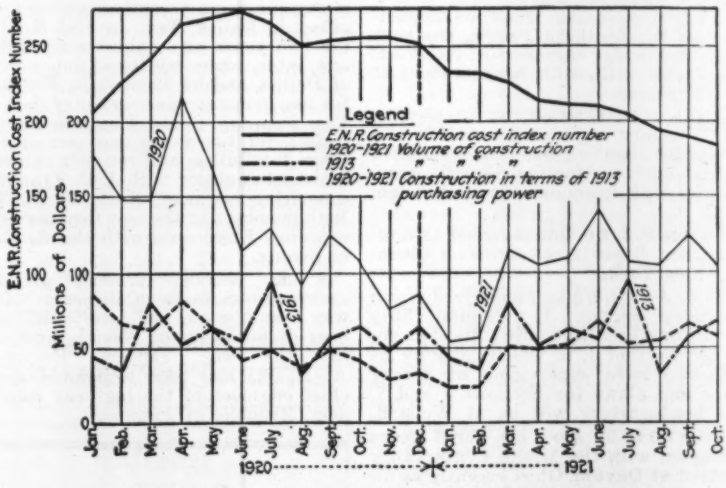
It is agreed that except for industrial works the country is underbuilt. It is generally believed that 1921 is an off year for construction. A definite reason for this paradox is the price situation.

Prices have fallen steadily since the peak in the summer of 1920. The *Engineering News-Record* Construction Cost Index Number shows this decline—fairly evenly downward in 1921. The chart giving the cost index number also carries the monthly volume of contracts let on all classes of engineering construction in 1920, 1921 and 1913.

Comparison of the actual volume of contracts let in 1920 and 1921 with 1913—as differing from a mere comparison of amounts of money—may be made by using the cost index number. By this means the actual volume of construction in 1920, computed from the total of contracts let, was 9 per cent less than the 1913 volume. Construction, or contracts let, in 1921 to Nov. 1 is 15 per cent less than in the ten months of 1913. This means that the amount of construction this year is 85 per cent of the amount in 1913.

Uncertainty as to future prices has been a major factor in this falling off of construction. Construction cost has declined 39 per cent since the peak in June, 1920, and is now about 66 per cent above the 1913 level. These figures include also the cost of labor. For the entire country common labor has fallen from 64 cents per hour to an average of 45 cents. In certain sections rate-cutting has been radical, while elsewhere, as in New York, peak rates are still in force. Common labor can be hired in the South for as low as 15 to 20 cents per hour. The 1913 average for the country may be taken as 22 cents per hour. It is therefore probable that labor cost will continue to decline in 1922, and this will work to draw certain materials below present levels.

If prices thus continue their decline there will remain a measureable uncertainty in the construction industry. It must be borne in mind, however, that any future decline in prices will not be from a peak, but from levels that are already satisfactory in many instances. Therefore, there should not be anything like the uncertainty that has prevailed since the summer of 1920 to date. Furthermore, the volume of construction of an urgent nature is steadily swelling and a certain proportion of this must be released, irrespective of market conditions. It seems safe to predict that 1922 will be a considerably better construction year than the present, and that the years following will show the Construction Industry really catching up.



TWO YEARS OF E N R. COST INDEX; AND CONSTRUCTION VOLUME FOR 1913, 1920 AND 1921

Cement Output Up in October

Cement shipments for October exceeded production and were the largest recorded for a single month. Stocks of finished cement at the mills at the end of October were approximately 5,348,000 bbl., compared with 6,953,000 bbl. at the beginning of the month. The production of clinker, or unground cement, in October was approximately 9,891,000 bbl. Clinker production for the ten months amounted to approximately 82,419,000 bbl., or an average of 8,241,900 bbl. per month.

Reliable Pine Pile Prices

This list of current prices covering the sizes and lengths of pine piles used in the New York district has been compiled for *Engineering News-Record* by Conwell & Co., Norfolk, Va., which company will hereafter supply the pine pile quotations in the Monthly Prices of Construction Materials—next issue Dec. 1. Says W. W. Conwell, president:

"In making this schedule we have exercised the same care as we would had we been bidding on a project requiring timber of the lengths and sizes mentioned, and in fact they are the same prices we would quote to any of our customers in the above noted territory. We trust that the data will serve the purpose intended, at any rate we know that it is sufficiently comprehensive to enable any contractor to use it making estimates. We are really pleased to be of service to you in this matter, for we feel that these prices may serve as an inspiration to people who have prospective work to do and to get them started to doing it is a consumation to be devoutly hoped for."

PRICES PER LINEAL FOOT, PINE PILES WITH BARK ON, F.O.B. NEW YORK

Diameters	Points	Length	Barge	Rail
12 in. at butt.....	6 in.	30 to 50 ft.	$0.14	$0.19
12 in.–2 ft. from butt.	6 in.	59 to 59 ft.	.18½	.25
12 in.–2 ft. from butt.	6 in.	60 to 69 ft.	.21	.27½
14 in.–2 ft. from butt.	6 in.	50 to 69 ft.	.24	.23½
14 in.–2 ft. from butt.	6 in.	70 to 79 ft.	.25	.34½
14 in.–2 ft. from butt.	5 in.	80 to 89 ft.	.30	.42

Lumber Shipments Equal Orders

Figures for production, stocks and shipments furnished by the Southern Pine Association show that in the forty-two weeks ending Oct. 22 there were orders for 3,112,881,817 ft. b.m. of lumber. Total shipments reached 3,058,102,397 ft. b.m., of which 2,914,838,279 ft. b.m. were actually cut during that period. The West Coast Lumbermen's Association reports for the same period orders for 2,321,762,205 ft. b.m.; shipments, 2,268,825,776 ft. b.m. and production, 2,167,219,909 ft. b.m.

For the period ending Oct. 22, the combined report of these two associations showed shipments as great as the demand; indicating an increase in shipments and a decrease in demand in certain centers, from the recent high point. Production for the week ending Oct. 22 is the highest recorded this year. Recent price advances have stimulated the opening up of more mills.

Latest News—Orders for southern pine have fallen off during the last two weeks from the high period of the year established during September and October. Orders for the week ended Nov. 14 were only 68,000,000 ft. b.m. or about 8 per cent below the production for that week. Shipments have not fallen so greatly, the average shipment per mill since the first week in September being in excess of 600.000 ft. b.m., the figure attained the week ended Nov. 14.

The actual production for the week of Nov. 14 was 74,000,000 ft. b.m. or 18 per cent below normal. The total orders on hand amounted to 255,000,000 ft. b.m.

The West Coast Lumbermen's Association has started its long deferred litigation for lower rail freight rates and simplified tariffs. Shippers of West Coast forest products have tried out the increased rates now for more than a year, with the result that lumbermen are losing markets and the railroads are losing revenue. The governing board of the West Coast Lumbermen's Association is convinced that lower rates would have a tendency toward earning more revenue for the railroads, at the same time giving the East access to an abundant supply of lumber with which to meet its housing situation. The Association claims its attitude is co-operative.

Trend of Business

Stock Market—More activity last week than the week before, with rising prices; but business is chiefly of a professional nature. With money more plentiful there is the possibility of a bull market developing in the course of several months; ungoverned speculation, however, is not likely, stocks being in strong hands.

Bonds—Public interest centered in new flotations, which frequently are disposed of a few days after offering. Subscriptions to the $50,000,000 New York Telephone Co. refunding mortgage 6s totaled over $450,000,000, at about 100, despite the fact that a week before a similar investment with the same company was available at 98. The tremendous interest in this issue helped the high-grade public utility bonds. Municipals retained strength despite many new issue. Railroad bonds advanced, though trading was light.

Money—Call loans 4 to 5½ per cent, with as low as 3½ reported outside New York; time money at 5 per cent.

Foreign Exchange—Sterling rose to $4.50, the high price of the year, the previous record being $4.25 on May 19.

Textiles—Extremely small demand, with falling prices.

Steel—Ingot production at 40 to 45 per cent capacity, against 44 per cent for October, and an increase hardly expected before Feb. 1. The total annual capacity is about 52,000,000 gross tons of ingots, 40,000,000 gross tons of finished rolled steel. Armament making takes less than one per cent of capacity, so a naval holiday should not seriously affect the industry. Railroad buying in October estimated at $50,000,000, and prospects for still heavier buying are good.

West Coast Lumber for Coney Island Broadwalk

The lumber contract for surfacing Coney Island's new boardwalk has just been awarded a San Francisco concern on specifications calling for 1,360,000 ft. b.m. of 2 x 4-in. vertical grain Douglas fir of the decking grade. The contract calls for 760,000 ft.b.m. of Douglas fir in 23-ft. lengths; 650,000 ft.b.m. in 18-ft. lengths; and 250,000 ft.b.m. in lengths of 12 ft. and up.

Engineering News-Record's Materials Prices

Weekly Market Compiled by Nine Reporters; Monthly List the Work of Twenty

One of the chief difficulties in the way of presenting accurate and definite price information useful to engineers, contractors and sellers of construction materials, is the fact that a price in itself means next to nothing. Quotations always require explanation. It is not enough to say that cement costs $2.40 per bbl. in New York. Cement also costs $2.10 in New York. It all depends whether the contractor or dealer is buying. Again, if the charge for bags is added, cement then costs $2.80 and $2.50, to contractor and dealer, respectively. Carrying the explanation further, the contractor's price includes delivery on the job, while the price to dealers is "alongside dock."

As in the case of cement, so with lumber, sand, gravel, crushed stone, brick, lime, and the rest. Methods of basing quotations vary with the different classes of materials, and the methods prevailing in one city may be entirely different from those in another center. In New York *Engineering News-Record* quotes sand, gravel and stone alongside dock, because contractors are permitted to purchase these materials on that basis. Cement, on the other hand, must be bought through dealers, who quote only delivered prices. In certain other cities, where cement may be obtained directly from the manufacturer, we quote f.o.b. City.

The fullest use of the prices of construction materials published by *Engineering News-Record* requires that the quotations be thoroughly understood. The weekly market of basic materials carries a complete explanation in small type directly under the tabulation of prices from nine important cities. The complete list, published in the first issue of each month, contains as much explanation as is possible without making the price section cumbersome. Also, a rapid, skeleton review entitled "Ups and Downs of the Market" leads the monthly list of prices.

Turn the page and study the Weekly Construction Market. It is as accurate as watchfulness and nine price reporters can make it. Next week's issue, Dec. 1, will carry the monthly labor article and the full list of prices of construction materials.

Recent Municipal Bond Sales Total $60,890,970

More than $60,000,000 in municipal bonds have been sold recently in thirteen states and more than $34,000,000 in addition have been offered for sale. Besides, $10,000,000 in state bonds have been sold and an equal amount has been offered for sale. These statistics have been compiled as a part of a study being made regarding public works and the possibility for hastening construction to relieve in some measure the nation's unemployment. The statistics were compiled by the President's Conference on Unemployment. Public works, which it is hoped will be erected or extended by these municipal bonds, include highways, schools, sewers, filtration plants, water works, hospitals, parks, forest reserves, bridges, lights,

paving, court houses, fire department and street department equipment, streets and sidewalks, beach improvements and memorial playgrounds.

Col. Arthur Woods, chairman of the committee on civic and emergency measures of the President's Conference on Unemployment, is in correspondence with mayors of cities of more than 20,000 inhabitants to learn the status of their unemployment and what emergency measures are being taken to provide employment for men and women who need it.

Vanderlip on a World Bank

The temptation to enter upon a process of depreciation by issuing too much paper money on the theory that what has seemed to help German industry might do something for manufacturers in other countries was declared by Frank A. Vanderlip, the American banker, recently, to be a certain path to national bankruptcy. As a means of stabilizing international finance he has put forward the idea of a world bank, with an international dollar.

According to Mr. Vanderlip the plan would leave every finance free to go on printing as many notes of his own national currency as he please; it would merely establish a double currency, such as already exists in some of the South American countries and in the Far East. In brief, the proposition is to organize a banking corporation with a paid-in capital of $1,000,000,000 in gold, with power to increase, the capital to be divided into shares of $100 each. Subscription to these shares would be open to anyone able to buy with gold.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 3, the next, on December 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	−$2.78	$4.00	$4.00	$2.88	$3.06	$3.75	$3.70	$4.00	$4.00
Structural rivets, 100 lb.	3.70	5.25	5.50	3.43	4.15	4.25	5.50	−4.25	5.50
Reinforcing bars, ¾ in. and larger, 100 lb.	−2.68	3.20	3.50	2.68	3.08½	3.57½	2.90	3.75	3.25
Steel pipe, black, 3½ to 6 in. lap, discount	51%	−57.65%	45%	57%	58.9–5%	38%	51.8%	50%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	+45.00	54.30	42.60@44.10	47.80	+72.00	50.00	53.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.40	+2.69	2.55	1.97	2.26	3.10	2.84	3.10	3.12
Gravel, ¾ in., cu.yd.	1.75	−1.85	2.25	1.65	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd.	−1.00	−1.25	2.25	1.65	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.80 to 1.90	−2.00	3.20	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+47.50	38.00	37.00	48.00	35.00	50.00	30.00	24.00	120.00
Lime, finishing, hydrated, ton.	16.99	19.00	25.00	18.00	29.00	30.00	22.00	−27.00	21.00
Lime common, lump, per bbl.	−3.39@3.69	−1.50	2.75	1.40	1.40	2.95	1.90	+3.25	15.00
Common brick, delivered, 1,000.	18.40	−9.00	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	−.0675	.124	.0821	.092	.09	.12½	.10	.08@.29
Hollow partition tile 4x12x12, block	.11120	−.0675	.124	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.72	−.79	−.85	+.76	.80	+.92	.83	.79	.85
Common Labor:									
Common labor, union, hour.	.75	.35	.....	.72½	.50	.50@.55	.75	.50@.60	....
Common labor, non-union, hour.	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

The only advances in prices of construction materials, reported from eight representative American cities, occur in cast-iron pipe, cement, lumber and linseed oil. Cast-iron pipe is quoted in Atlanta at $45 as against $40.50. Cement has advanced 9c. per bbl. in Atlanta. Pine lumber is quoted at $42.50, wholesale, as against $40 per M ft. in New York. Linseed oil advanced 2c. in Denver and Chicago, but dropped 8c. in Dallas and 6c. per gal. in Atlanta. Increased demands in these four commodities have been reflected in stimulated prices; while twelve of the other principle materials in the construction market show a downward trend in price.

The minimum of $1.50 on steel shapes and bars continues to be quoted, on large tonnages, at the Pittsburgh mills; small tonnages 5c.@10c. per 100-lb. higher. Regardless of the stability of the mill price on large tonnages, the New York warehouses quote a drop of 10c. per 100-lb. on structural shapes and reinforcing bars. Shapes are quoted at $2.78 as against $2.88 and bars at $2.68 as compared with $2.78 per 100-lb., previously.

Structural rivets are quoted in Seattle at $4.25 as against $4.50 per 100-lb. Atlanta quotes reductions ranging from 10c to 15c. per cu. yd. in all concreting materials excepting cement; a drop of 10c. per bbl. in common lump lime; a decrease of $1.50 per 1000 in common brick and a slight reduction in hollow tile. New York quotes sand at $1 as against $1.25 per cu.yd. and common lump lime at $3.39@$3.69 as compared with $3.69 per bbl., formerly.